

MOSS FLORA

OF

NORTH AMERICA

North of Mexico

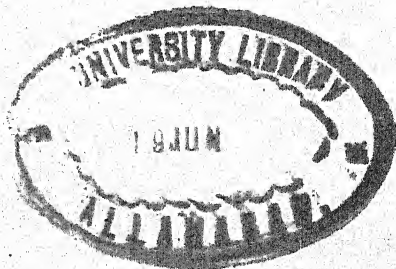
BY

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Subfamily AMBLYSTEGIEAE.

Plants of various habits and habitats; central strand always present in the stems (except *Hygrohypnum montanum*, *Drepanocladus vernicosus* and occasionally in other species); costa present (except *Campylium* and *Hygrohypnum* species and in *Calliergonella*). Paraphyllia rarely present (except in *Cratoneuron*). Leaf cells smooth, elongated, often narrowly linear (in *Amblystegium* species 2-3: 1), with few exceptions thin-walled; alar cells often enlarged and inflated. Capsules more or less curved and unsymmetric, usually cernuous; peristome perfect or in a few cases with poorly developed cilia. A large proportion of the species of this subfamily are aquatic or moisture-loving.

KEY.

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| 1. Leaves strongly bordered with thick-walled narrow cells..... | 4. <i>Sciaromium</i> . |
| Leaves not bordered..... | 2. |
| 2. Paraphyllia abundant and striking..... | 5. <i>Cratoneuron</i> . |
| Paraphyllia lacking or very few and inconspicuous..... | 3. |
| 3. Leaves having single costa to middle or beyond and slenderly pointed, with few exceptions falcate-secund..... | 12. <i>Drepanocladus</i> . |
| Leaves not as above, those with single costa not falcate-secund (except <i>Hygrohypnum</i> forms); if secund, costa double or lacking..... | 4. |
| 4. Costa very strong and percurrent or excurrent..... | 5. |
| Costa seldom reaching beyond middle of leaf, often short and double or lacking..... | 7. |
| 5. Leaves acuminate, usually very acute..... | 6. |
| Leaves obtuse and rounded at apex or shortly apiculate, often cucullate... | 9. <i>Calliergon</i> * |
| Leaves acuminate but obtuse at apex. Species of..... | 7. <i>Hygrohypnum</i> . |
| 6. Aquatic, growing chiefly on stones in streams..... | 7. <i>Hygroamblystegium</i> . |
| Not aquatic, growing on various substrata, species of..... | 2. <i>Amblystegium</i> . |
| 7. Aquatic; leaves mostly obtuse or broadly acute with short or double costa. | 8.** |
| Not aquatic, or if aquatic with slenderly acuminate leaves having a single costa..... | 9. |
| 8. Plants very large and dark colored, leaves rugose when dry; costa very faint and double or lacking..... | 8. <i>Scorpidium</i> . |
| Plants medium to small; leaves not rugose; costa usually conspicuous..... | 7. <i>Hygrohypnum</i> . |
| 9. Plants small; leaf cells 2-3: 1. Species of..... | 2. <i>Amblystegium</i> . |
| Plants medium sized to large; leaf cells 5-15: 1..... | 10. |
| 10. Leaves with single costa reaching the middle of leaf or beyond..... | 11. |
| Leaves ecostate or with costa short and double..... | 11. <i>Calliergonella</i> † |
| 11. Leaves acuminate and acute at apex..... | 12. |
| *Leaves obtusely acuminate..... | 10. <i>Calliergidium</i> . |
| Leaves broadly obtuse and rounded or apiculate at apex..... | 9. <i>Calliergon</i> . |
| 12. Leaves widely spreading to squarrose (except <i>polygamum</i>); costa in several species short and double or forking..... | 6. <i>Campylium</i> . |
| ***Leaves spreading to erect-spreading; costa always well developed and single. | 1. <i>Leptodictyum</i> . |

1. LEPTODICTYUM (Schimp.) Warnst. Laubm., Kryptogamenfl. Mark Brand. 2: 840. 1906.

Leptodictyum Schimp. subgenus of *Amblystegium*, Syn. (Ed. 1) 595. 1860.

Plants small to large, growing in water or damp places, in rather loose mats, sometimes floating, attached to humus, stones, and wood, or less frequently found on soil. Leaves spreading to erect-spreading, nearly or quite plane and entire on the margins; costa well developed, reaching the middle of the leaf or beyond, not percurrent; median leaf cells elongated-hexagonal to linear, thin-walled. Sporophyte as in *Amblystegium*

* Except *C. pseudosarmentosum*.

** *Leptodictyum riparium* obtusifolium and *L. vacillans* may be sought here, also *Drepanocladus* forms.

*** See also *Drepanocladus*.

† See also *Campylium*.

but sometimes smaller and with a shorter capsule. Differs from *Amblystegium* in the longer, thinner-walled leaf cells.

Type or standard species, *L. riparium*.

KEY.

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| 1. Plants usually aquatic and floating | 6. |
| Plants smaller, not floating, few aquatic | 2. |
| 2. Stem and larger branch leaves broadly ovate to ovate-lanceolate, acute to acuminate; median leaf cells 3-6:1 | 3. |
| Stem leaves ovate-lanceolate to narrowly lanceolate; median leaf cells 5-10:1 | 4. |
| 3. Some or all of the leaves slenderly acuminate | 5. <i>trichopodium</i> . |
| Leaves acute to short-acuminate | 2. <i>brevipes</i> . |
| 4. Leaves distant, separated by nearly their own width | 3. <i>sipho</i> . |
| Leaves not so distant, sometimes crowded | 5. |
| 5. Apex of branch leaves rather blunt | 4. <i>vacillans</i> . |
| Apex of leaves slender (typical) | 1. <i>riparium</i> . |
| 6. Leaves all gradually acuminate and acute. Varieties of | 1. <i>riparium</i> . |
| Many leaves, especially of the branches, obtuse | 7. |
| 7. Plants small to medium in size; leaves 2 mm. long or less. Rare and confined to the northern U. S. and Canada | 4. <i>vacillans</i> . |
| Plants larger; leaves 3-4 mm. long. Common in the eastern U. S. from New England to Florida | 1. <i>riparium obtusifolium</i> . |

1. LEPTODICTYUM RIPARIUM (L. Hedw.) Warnst. l. c. 878.

Hypnum riparium L. Sp. Pl., 1129. 1753. Also Hedw. Sp. Musc. 241. 1801.

Amblystegium riparium Br. & Sch., Bry. Eur. fasc. 55-56, pl. 570 & 571. 1853.

Stereodon riparius Mitt. Journ. Linn. Soc. 8: 43. 1864.

Amblystegium laxirete Card. & Thér. Bot. Gaz. 27: 379. pl. 25. 1904.

Plants exceedingly variable in size and habitat, variations seemingly dependent in large measure upon the amount of moisture and the kind of substratum; typically creeping with long (± 10 cm.) stems irregularly branching with rather short spreading branches, forming loose mats, or longer and floating in some of the varieties; stem leaves long (2-2.5 mm.), rather distant, *widely spreading both wet and dry*, often subcomplanate, *rarely* slightly secund at the ends of stem and branches, *with plane entire margins*, broadly ovate-lanceolate to elongated-lanceolate, slightly or not at all decurrent, somewhat clasping but not auriculate, *gradually tapering to the long slender acumination*, which typically ends in a single long narrow cell; costa strong at the base, extending $\frac{1}{4}$ - $\frac{3}{4}$ the length of the leaf; leaf cells in the median region *narrowly linear-rhomboidal*, about 8 μ wide and 8-12 (rarely 15) times as long, thin-walled, towards the base gradually broader and shorter; basal and alar cells subrectangular, one or two at the margins often more elongated. Autoicous; sporophyte pale, yellowish to light brown, turning reddish; seta 1-2.5 cm. long; capsules oblong to cylindric, inclined and arcuate, reaching 2.5 x 1 mm., constricted under the mouth when dry and empty; operculum conic-apiculate; annulus broad; peristome perfect with cilia 1-4; "spores at all seasons" (Dixon).

Type locality, Thames River, England. "Type probably not in existence." (Cheney.)

ILLUSTRATIONS.—Br. & Sch. l. c.; Dixon & Jam. Handb. Brit. Mosses, pl. 57; Braithw. Brit. Moss Fl. pl. 89; Jennings, Mosses W. Pa. pl. 38; M. H. M. 339; Cheney, Bot. Gaz. 24: pl. 13, f. 1; Pl. 15 A figs. 3, 4, 5 & 6.

EXSICCATI.—Drumm. Musc. Am. 170; Sull. Musc. Allegh. 54 and 56; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 349, (Ed. 2) 527; Aust. Musc. Appal. 387, 388; Macoun, Can. Musc. 325; Grout, N. Am. Musc. Pl. 163, 206 & 488; Ren. Card Musc. Am. Sept. Ex. 329.

Common in wet places across the continent. Apparently more common east of the Rockies. Represented in the southeastern U. S. chiefly by f. *obtusum*.

Under this species in my herbarium I found *L. trichopodium* var. *Kochii*, *Campylium polygamum*, *Drepanocladus Kneiffii* and *Brachythecium acutum* and this diversity of determination was due, not to gross carelessness on the part of the sender but to a most striking resemblance to some of the forms of this species. Careful study will distinguish the *Brachythecium* by its slightly serrulate leaves on some parts of the plant and the darker capsules.

The *D. Kneiffii* may be distinguished from f. *longifolium* by means of its inflated auricular cells alone. Forms of *L. riparium* of the smaller varieties are at times almost indistinguishable from *L. trichopodium* but in most cases *trichopodium* has broader and shorter leaf cells and more slenderly acuminate

leaves. *C. polygamum* is about the size of some of the smaller forms and varieties, but its leaf apices are channeled and the leaves are more or less auricled. To add to the confusion there are unusual forms of *riparium* with somewhat secund leaves (forma *subsecunda* Br. & Sch. l. c.) and I found one undoubted form of *riparium* with the margins of some of the upper leaves incurved so as to make the apex channeled.

Forma LONGIFOLIUM (Schultz).

Hypnum longifolium Schultz, Fl. Starg. 335. 1806.

This is one of the largest forms, yellowish green, turning dark with age, reaching 8 cm. in length, usually floating, little branched, leaves usually more distant and subcomplanate, 3.5-4.5 mm. long, rarely 5 mm., 0.6-0.7 mm. wide, with a very long filiform acumination: seta reaching 3-6 cm. Rarely fruiting. Common, probably with the range of the species.

ILLUSTRATIONS.—Pl. 15 A, figs. 1 & 2.

EXSICCATI.—Grout, N. Am. Musc. Pl. 50.

The basal, especially the alar cells of this variety are often somewhat swollen but they do not form auricles as in *Drepanocladus Kneiffii*.

Forma FLUITANS (L. & J.).

Hypnum riparium var. *fluitans* L. & J. Manual 377. 1884.

Very robust, 10-20 cm. long, floating in shallow water at edges of streams, dirty green or yellowish; leaves 0.8 x 3.2 mm., sometimes reaching 4 x 1 mm. lacking the extreme filiform acumen of var. *longifolium*.

Neither Cheney nor I have seen sporophytes. This is much less frequent than the preceding or the next variety.

Forma OBTUSUM (Grout) (as *Amblystegium*) Grout, N. Am. Musc. Pl. 471. March 10, 1917.

Robust, floating, scarcely to be distinguished from f. *fluitans* except for the bluntish apex of the leaf which much resembles that in *L. vacillans*, to which this form has often been referred, but this variety is much more robust and has fewer and less distinct alar cells; leaves 3 mm. long, occasionally reaching 4 mm., about .75 mm. wide; alar cells much as in the typical form, sometimes with elongated cells at the basal margin as shown in the illustration, but these are not inflated nor do they form auricles.

ILLUSTRATIONS.—Pl. 15, figs. 7, 8, 9, 10, 11.

EXSICCATI.—Grout, N. Am. Musc. Pl. 355, type, from New Haven, Ct., Nichols, 465, 471.

This seems to be the most common floating form along the Atlantic seaboard, especially in the South. It is very common in Florida.

Forma FLACCIDUM (L. & J.)

Very much attenuated, filiform, sparingly branched; leaves distant about their own width, narrowly lanceolate and slenderly acuminate.

Type, N. American. Type not located, not to be found in James Herbarium, Harvard Univ.

ILLUSTRATIONS.—Jennings, Mosses W. Pa. pl. 38; Pl. 16, figs. 1 a-z.

EXSICCATI.—Drumm, Musc. Am. S. States 115. Aust. Musc. Appal. 389; Grout, N. Am. Musc. Pl. 113, 417; 295 is a form intermediate between species and variety.

It seems probable that this is the same form as the European var. *inundatum* (Schimper) Warnst. Growing in water, generally in the shade, frequent.

Var. ABBREVIATUM (Br. & Sch.) Grout, l. c.

Amblystegium riparium abbreviatum Br. & Sch., l. c.

The smallest, most condensed form of the species. Typically with short stems and crowded leaves but more lax forms are found; leaves 1-2 mm. long; capsules short, sometimes only 0.8 mm. long, ovoid to oblong.

ILLUSTRATIONS.—Bry. Eur. pl. 571, f. β 1-2.

EXSICCATI.—Grout, N. Am. Musc. Pl. 178.

I think Sull. Musc. Allegh. 55 and Drumm., Musc. Am. S. States 117 are this variety.

Variety *abbreviatum* with its typically closely matted growth, small crowded leaves, short seta and capsule is so different from the large floating varieties as to make it seem foolish at first sight to include them in the same species yet a complete series of intergradations is present and subaquatic mosses are notoriously variable.

Var. BRACHYPHYLLUM (Card. & Thér.) Grout, l. c.

Amblystegium brachyphyllum Card. & Thér. Minn. Bot. Stud. 3²: 123, pl. 20. 1903.

I have seen the type collection sent me by Holzinger (near Granite Falls, Yellow Medicine County, Minnesota, near lat. 45° N., July 15, 1901). It differs in only one particular from the frequently occurring terrestrial form of the species with broad short leaves and wide leaf cells. It has many blunt-pointed leaves after the manner of *f. obtusum* and bears the same relation to the form with broad short leaves mentioned above that *f. obtusum* does to *f. longifolium*.

ILLUSTRATIONS.—Pl. 16, f. 3 a-d.

†Var. *ELONGATUM* (Br. & Sch.) Bry. Eur. l. c. One of our handsomest forms. The branches are usually complanate-foliate. The leaves a little less filiform-acuminate than in var. *longifolium*, crowded, imbricate and bright golden-yellow.

A form of this variety collected near mouth of Sand Coulee, Montana, has a sporophyte like a *Brachythecium* with short seta and short ovoid capsules. N. Am. Musc. Pl. 463 is typical of this variety.

As in so many subaquatic plants there is an extreme range of variation in this species due to habitat conditions largely, but even in similar habitats there seems to be great variation. In large floating forms *f. longifolium* has very long filiform-acuminate leaves, rather distant; if the leaves are a little less filiform-acuminate, crowded, imbricate and bright golden yellow it becomes var. *elongatum*.

If the leaves are a little shorter than in these two varieties with a normal apex it may be called var. *fluitans* and if many of the leaves have an obtuse apex it is *f. obtusum*. If the plants be very slender with distant leaves it is *f. flaccidum*. The costa sometimes extends almost to the apex of the leaf. Such forms are called var. *longinerve* by Cardot and Thériot.

The variation towards broad short leaves with wide cells produces numerous plants hard to distinguish from *L. trichopodium* and terminates in the subspecies *L. brevipes*. Sometimes these leaves may appear on the branches of plants whose stems have typical leaves as in Pl. 15A, figs. 4 & 5 taken from plants of my N. Am. Musc. Pl. 295. Ordinarily these leaves seem to indicate a drier habitat but Dr. Conard sent me *L. brevipes* from the intake of a concrete water-tank in swift water.

From a large series of forms contributed by Dr. H. S. Conard from Illinois and Iowa, it seems that the terrestrial forms of this species from the midwest tend towards the *laxirete-brevipes* forms of leaf and leaf-cells. *Amblystegium laxirete* Card. & Thér. (Bot. Gaz. 37: 379, pl. 25. 1904) according to type material, description and figures differs from ordinary forms of *L. riparium* in nothing but the somewhat shorter and broader leaf cells, 60–80 x 12 μ , and very soft flaccid leaves.

Var. *serratum* (R. & C.) Grout, Check List, 13, can I think be safely ignored as a freak or more probably a form of *Brachythecium acutum*.

*2. *LEPTODICTYUM BREVIPES* (Card. & Thér.) Broth. Engler & Prantl. Musc. (Ed. 2.) 2: 337. 1925.

Amblystegium brevipes Card. & Thér. Minn. Bot. Stud. 3*: 124, pl. 20. 1903.

"Stems slender, creeping, with short branches. Leaves erect open, about 1.2 x 0.6 mm., broadly ovate, short-acuminate, entire; costa narrow, 30 μ wide at base, vanishing above the middle, often extending $\frac{3}{8}$ – $\frac{3}{4}$ the length of the leaf, areolation lax; basal cells rectangular to quadrate, median subhexagonal, 55–70 x 12–15 μ , upper shorter and broader. Perichaetial leaves broadly ovate, abruptly contracted to a narrow acumen, often irregularly denticulate at base of acumen, costa extending beyond the middle. Seta about 1 cm. long; capsule \pm 1.5 mm. long, oblong-arcuate, constricted under the mouth when dry; operculum conic."

"This species differs from the small forms of *Amblystegium riparium* by the shortly acuminate leaves, the looser areolation, the shape of the perichaetial leaves, and the shorter pedicel" "Habitat" (of type) "near Montevideo," Minn. Also at Hartford, Minn.

ILLUSTRATIONS.—Card. & Thér. l. c.; Pl. 15B, figs. 1, 2 & 3, also Pl. 16, figs. 2 a–h.

Similar but less extreme forms are often found in collections under the name of *Amblystegium Kochii*.

Dr. H. S. Conard collected a moss at the "intake of a concrete water tank" in swift water shaded by a roof "near Grinnell, Iowa, no. 405, Oct. 12, 1928," that seems clearly to belong here. J. L. Sheldon's 2343 from Short Creek, W. Va., June 21, 1906, is referred to this species. The costa of the perichaetial leaves in some cases was practically percurrent. Also Omaha, Neb., K. Wolfe no. 10.

*3. *LEPTODICTYUM SIPHO* (P. B.) Broth. Engler & Prantl, Musci (Ed. 2) 2: 337. 1925.

Hypnum siphon P. B., Prod. 70. 1805.

Amblystegium riparium floridanum R. & C., Bot. Gaz. 14: 98. 1889.

Amblystegium floridanum R. & C., Musc. Am. Sept. no. 58. 1893.

Plants light green, small; stems 1–2 cm. long, sparsely branched; leaves distant, narrowly lanceolate, 0.8–1.2 mm. long; stem leaves reaching 1.8 mm.; leaf cells about as in the broader-leaved forms of *L. riparium*. Seta about 1 cm. long; capsule 1–1.5 mm. long. Spores in spring.

† Probably identical with var. *splendens* De Not.

Type locality N. Carolina, Bosc.

ILLUSTRATIONS.—Cheney, Bot. Gaz. 24: pl. 13, f. 2; Cardot, Bull. Herb. Boiss. 8: 336. pl. 10; Pl. 15 C, f. 1-5 & Pl. 16, figs. 6 & 7.

EXSICCATI.—R. & C., l. c.; Grout, N. Am. Musc. Pl. 248.

On decayed wood and humus in the South Atlantic and Gulf States. Common in Florida, probably elsewhere. Subspecies of *L. riparium*, combines the characters of *L. riparium abbreviatum* as to size and var. *flaccidum* as to shape and arrangement of leaves.

*4. LEPTODICTYUM VACILLANS (Sull.) Broth. l. c.

Amblystegium vacillans Sull. Icon. Musc. Suppl. 96, pl. 72. 1874.

Plants loosely cespitose, yellowish green, prostrate, sparingly branched, stems 2-6 cm. long, central strand poorly developed; stem leaves rather distant, erect-spreading, narrowly lanceolate, slenderly acuminate, reaching 0.7 x 2 mm.; branch leaves smaller, 0.35 x 1.2 mm., slenderly acuminate, rather obtuse at the apex, with entire plane margins; costa extending beyond the middle; median cells 30-50 x 7 μ . Monoicous; sporophyte not to be distinguished from that of the smaller forms of *L. riparium* of which this is at most a poorly delimited subspecies, distinguished by its small or medium size and the bluntish apex of the branch leaves. Forma *obtusum* of *L. riparium* has similar leaf apices but it is a much larger floating form. The two have often been confused.

Type from the White Mts. of New Hampshire. In a specimen of Oakes' New Hampshire collection in my herbarium the alar cells are like those figured by Sullivant rather than those figured by Cheney. The branch leaves have been described from one of Oakes' White Mt. plants.

ILLUSTRATIONS.—Sull. l. c.; Cheney, Bot. Gaz. 24: pl. 12, f. 4; M. H. M. 340.

Owen Sound, Ontario, Moxley!! Ogdensburg, Sussex Co., N. J. Aust. in Herb. N. Y. Bot. Garden and Bay of Quinte, Ontario, Macoun, 1868, determination doubtful. N. Am. Musc. Pl. 282 is *Calliergidium pseudostramineum* (Ren.) Grout. No. 458 proves to be an aquatic form of *Dicranella squarrosa*.

5. LEPTODICTYUM TRICHOPODIUM (Schultz) Warnst. Laubm., Kryptogamenfl. Mark Brand. 2: 881. 1906.

Hypnum trichopodium Schultz, Fl. Starg. 324. 1806.

Amblystegium riparium var. *trichopodium* Br. & Sch. Bry. Eur. fasc. 55-56, pl. 571. 1853.

Amblystegium ambiguum De Not. Epil. Bry. Ital. 144. 1869.

Plants growing in loose wide tufts or mats, usually light green or yellowish, darker in the older portions; stems 2-4 cm. long, central strand present; branches prostrate to ascending-erect; stem leaves loosely to widely spreading, not crowded, slightly or not at all decurrent, often slightly serrulate by projecting cells on the plane margins, ovate to ovate-lanceolate, widest in the basal eighth, rather abruptly long-acuminate, 0.7-0.8 x 1.2-1.6 mm.; costa strong, reaching $\frac{6}{7}$ length of leaf, rarely almost percurrent, usually shorter; leaf cells thin-walled; median elongated hexagonal to rhomboidal, 9-12 μ wide and 3-5 times as long, becoming wider below, at base rectangular to oblong in several rows, angular cells scarcely different; branch leaves smaller and narrower, ovate-lanceolate to lanceolate.

Monoicous: sporophyte light brown, darker with age; seta 2.5-4 cm. long; capsule ovoid to oblong-cylindric, unsymmetric and cernuous or subarcuate, 2-3 x 0.75-1 mm.; operculum conic-apiculate; annulus present; stomata numerous; peristome-perfect; spores from late autumn to early spring.

Type locality European.

ILLUSTRATIONS.—Br. & Sch. l. c.; Cheney, Bot. Gaz. 24: pl. 12, f. 5; Braithw. Brit. Moss Fl. pl. 89; Pl. 16, f. 12.

EXSICCATI.—Drumm. Musc. Am. (S. States) 189 as *Hypnum radicale*; Grout, N. Am. Musc. Pl. 48 (issued as *Hypnum chrysophyllum*).

Var. *Kochii* (Br. & Sch.) Broth. Engler & Prantl, Musci (Ed. 2.) 2: 337. 1925.

Amblystegium Kochii Br. & Sch., l. c. pl. 568.

While there seems to be no doubt that *trichopodium* and *Kochii* are not specifically distinct it is not so clear what is the distinction between the species and the variety. *L. trichopodium* has been described from specimens sent me by Loeske which he assures me have been compared with the original and found practically identical.

The form regarded as var. *Kochii* is well illustrated by the Bryologia Europea plate. Compared with *trichopodium* the stem leaves are more broadly ovate, costa thinner and not extending much beyond the

middle. Both species and variety are frequent across northern N. America, less frequent in the southern states of the U. S., Texas and Mexico.

ILLUSTRATIONS.—Br. & Sch. l. c.; M. H. M. 332.

EXSICCATI.—Drumm. Musc. Am. 189 (as *Hypnum radicale*).

Var. *CURVIPES* (Br. & Sch.) Broth. l. c.

Amblystegium curvipes Br. & Sch., l. c., pl. 569.

The extreme broad-leaved form with a short thin costa and softer leaves is credited to N. America by Brotherus. A form collected by Macoun at Lytton, B. C., April 17, 1889, is the nearest to this variety that I have seen. It was issued as *Hypnum hispidulum*.

Forma *robusta* Loeske Mss. has leaves reaching 2 mm. long and is often as large as *riparium*.

Forma *simulans* Grout n. f. is a form chiefly of the *Kochii* type, having a group of small subquadrate cells at the basal angles as illustrated in Pl. 16, f. 11, a-c. (See note on *Amblystegium Juratzkanum*, from which it is difficult to separate this form except by the larger size and the less slender branch leaves.) Type from Idaho, Heller. Type in Herb. A. J. G. Macoun's Can. Musci 844, determined Kindberg in herb. N. Y. Bot. Garden is close to this form.

I find this species and its varieties in swamps associated with *L. riparium* but in general it is less aquatic. Large forms are difficult to separate from the form of *L. riparium* with short broad leaves and wider cells like those drawn by Cardot to illustrate his *Amblystegium brachyphyllum*. At the other extreme it seems to fade into *Amblystegium Juratzkanum* and *A. varium*. *Juratzkanum* is usually smaller, with branch leaves more slender and more serrulate. *Varium* has a longer stronger percurrent costa and even shorter and smaller leaf cells, 3:1. Either these species intergrade or hybridize and they certainly grow intertangled.

The form I have called the typical *trichopodium* is not the same as described by Limpricht. The form I have taken as typical with the strong long costa tends to have a row or two of somewhat inflated cells at the basal angles after the manner of *Hygroamblystegium irriguum*.

2. AMBLYSTEGIUM Br. & Sch. Bry. Eur. 1853.

Plants small, prostrate, creeping, often with erect or ascending* branches, dark to bright or yellowish green, irregularly and often freely branched, growing in moist places over various substrata, rarely aquatic; central stand present. Leaves spreading to erect when dry, usually equally spreading but rarely somewhat secund, more or less decurrent, ovate-lanceolate to lanceolate, acute to acuminate, serrulate to entire, costate to the middle or beyond, flat or somewhat concave but not plicate, with plane margins; leaf cells short, 5:1** or less, basal cells shorter and broader, parenchymatous; alar often somewhat enlarged but not abruptly so nor forming auricles. Nearly always monoicous. Sporophyte large for the size of the plants; seta smooth; capsule inclined to horizontal, unsymmetric to arcuate, usually subcylindric, strongly curved and constricted under the mouth when dry, pale to dark brown, sometimes reddish; operculum conic, not rostrate; annulus usually present; peristome of the perfect hypnaceous type.

The small size of the plants, the short leaf cells and comparatively large capsules make the genus fairly easy to recognize. *A. Juratzkanum* grades into *Leptodictyum trichopodium*, but in most cases is distinguished by smaller size, shorter marginal leaf cells and more generally serrate leaf margins. Through *A. varium* this genus approached *Hygroamblystegium irriguum*. *Brachythecium reflexum* has the short cells of this genus but is distinguished by the triangular-ovate stem leaves, ovoid capsules and the rough seta. *Hygroamblystegium* is distinguished by the thicker costa and the aquatic habitat.

Type species *A. serpens*.

KEY.

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| 1. Costa not percurrent, usually ending near the middle of the leaf..... | 2. |
| Costa percurrent in some of the leaves, usually in all..... | 3. |
| 2. Leaves usually widely spreading when dry; marginal cells at base of leaf oblong to rectangular..... | 2. <i>Juratzkanum</i> . |
| Leaves not widely spreading; marginal cells at base quadrate or transversely elongate..... | 1. <i>serpens</i> . |
| 3. Leaves entire; costa strong; leaf cells 5:1 or less..... | 3. <i>varium</i> . |
| Leaves serrulate; costa thin; leaf cells 6-10:1..... | 4. |
| 4. Plants usually in deep tufts or cushions, paraphyllia few or lacking..... | 4. <i>compactum</i> . |
| Plants in rather thick mats but not tufted; paraphyllia numerous..... | 5. <i>americanum</i> . |

* *A. compactum* usually grows in compact tufts like many of the acrocarpous mosses.

** *A. compactum* and *A. americanum* have leaf cells 6-10:1.

1. AMBLYSTEGIUM SERPENS (L., Hedw.) Br. & Sch. Bry. Eur. fasc. 55-56, pl. 564. 1853.

Hypnum serpens L. Sp. Pl. 1130. 1753, and Hedw. Sp. Musc. 268. 1801.

Hypnum spinulosum Hedw. Spec. Musc. 269, pl. 69, f. 5-10. 1801.

Hypnum contextum Hedw. l. c. 273, pl. 72, f. 5-12. 1801.

Plants slender, the smallest of our species, growing in rather thin mats, more or less densely interwoven, irregularly branching, not glossy; leaves moderately close together as a rule, *not widely spreading*; stem leaves ovate-lanceolate, long-acuminate, reaching 1.2 x 0.4 mm., but usually smaller, branch leaves smaller and lanceolate, both serrulate to entire, narrowed at the insertion and slightly decurrent; costa slender, reaching to the middle of the leaf or somewhat beyond; median leaf cells oblong-hexagonal to hexagono-rhomboidal, 30-55 μ long, 3-4:1, broader and subrectangular toward the base, *quadrate to transversely elongate at the basal margin*. Autoicous; seta 15-30 mm. long; capsule cylindric, curved and cernuous, contracted below the mouth when dry and empty; annulus of 2-3 rows of cells. Spores in spring.

"Type locality England. Type probably not in existence." Cheney.

Hedwig's type in Herb. Boissier?

ILLUSTRATIONS.—As above and Cheney, Bot. Gaz. 24: 257, pl. 11, f. 6.; Jennings, Mosses W. Pa., pl. 37; M. H. M., 330.

EXSICCATI.—Sull. Musc. Allegh. 29 (a form close to the next). Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 345, (Ed. 2) 523; Aust. Musc. Appal. 373; Grout, N. Am. Musc. Pl. 145, 145a, 176 & 130 (as *A. compactum*).

Common on moist substrata of all sorts, especially decaying wood. Found all over the world. Not likely to be confused with any other species except the next, into which it unquestionably grades. The distinctions in the key usually hold good.

Var. TENUE (Schr.) Bry. & Sch. l. c.

Hypnum tenue Schrad. Krypt. Gew. n. 80. 1796.

Exceedingly slender, filiform, with the habit of *Amblystegiella subtilis*; leaves distant, shorter, smaller and longer acuminate. Capsules small, often almost straight. Aust. Musc. Appal. 367 as *A. serpens tenellum* is this variety.

Var. BERINGIANUM Card. & Thér., Proc. Wash. Acad. Sci. 4: 338.

"Differs from the typical form in the broader ovate-lanceolate leaves with shorter acumination, the costa stronger, extending to the base of the acumination, basal cells rectangular with thickened walls."

Type from St. Paul Island (Trelease, 2089 in part).

For var. *giganteum* Grout, Bryologist 12: 96. 1909; see under the next species.

*2. AMBLYSTEGIUM JURATZKANUM Schimp. Syn. (Ed. 1) 693. 1860.

Plants in loose mats, bright green; *leaves widely spreading both wet and dry*; stem leaves ovate to ovate-lanceolate, long and slenderly acuminate; reaching 0.6 x 1.2 mm. in large forms; branch leaves smaller and narrower, narrowly lanceolate, more or less serrulate even to the base; costa extending beyond the middle, rarely almost percurrent; leaf cells oblong to linear-rhomboidal \pm 10 x 60 μ , longer and narrower towards the apex, *short-oblong to rectangular at the base and basal angles*. Monoicous; seta and capsule yellow or light brown, scarcely distinguishable from that of *A. serpens*.

Type locality Austria. Type in Schimper's herbarium.

ILLUSTRATIONS.—Braithw., Brit. Moss. Fl. 3: 25, pl. 91; Cheney, Bot. Gaz. 24: pl. 11, f. 7; Jennings, Mosses W. Pa., pl. 37; Pl. 16, figs. 11 a-b.

EXSICCATI.—Grout, N. Am. Musc. Pl. 358, 139 (this last contains *Campylium radicale* also); Aust. Musc. Appal. 384 in part, 374 is a form of this species.

Frequent throughout the northern U. S. and Canada on moist stones, soil and rotten wood. Less frequent southwards and in the Middle West; more abundant in the Far West.

The stem leaves are often much broader than figured by Cheney. Schimper in his original description says "e deltoideo-ovato." Braithwaite's figures are good.

A. Juratzkanum is at best a poorly delimited subspecies of *A. serpens*. It is usually larger, with more elongated marginal cells at base of leaf and longer and narrower leaf cells. The branch leaves are typically narrower, more slender and *more spreading* but all sorts of intermediate intergradations and combinations of these characters are found. Large forms in some cases are almost indistinguishable from *Leptodictyum trichopodium* var. *Kochii* but in most cases the leaves are more denticulate than in that variety.

Var. GIGANTEUM Grout n. comb.

Amblystegium serpens var. *giganteum* Grout, Bryologist, 12: 96. Nov. 1909.

Stem leaves triangular-ovate to ovate-lanceolate, long-acuminate; often scarcely to be distinguished from *Leptodictyum trichopodium* and its var. *Kochii* except that the leaves are more abruptly narrowed to the insertion and somewhat concave and subclasping at base with a longer and more slender acumination; a few of the rectangular cells at basal angles are oblong-rectangular, then above these at the widest part of the base is a group of small quadrate cells at the margin which often extend $\frac{2}{3}$ the way to the costa.

Type in herb. A. J. Grout, from Idaho, A. A. & Gertrude Heller, No. 2957. *Pl. 16, f. 11c.*

Forma *simulans* of *L. trichopodium* is very hard to distinguish from this variety. It is a parallel development.

Species of *Amblystegium* cannot accurately be distinguished without studying normal stem leaves. In this variety the characteristic alar cells are often wanting in the branch leaves and also in some of the stem leaves. Loeske, who has seen this form, referred it to *Juratzkanum* as a very large form and European plants of *Juratzkanum* sent me by him sometimes show a similar group of angular cells. All this goes to show that *Juratzkanum* is little more than a subspecies or variety of *serpens* and cannot be separated by the alar cells alone. If these cells were consistently present on all the stem leaves of each individual plant, var. *giganteum* might be regarded as a distinct species. This variety is a characteristic form of the Rocky Mts. and westward.

A careful study of this group of quadrate angular cells disclosed that they are found also in forms of undoubted *Leptodictyum riparium* (see N. Am. Musc. Pl. 295) and their presence or absence in this group is probably determined by habitat conditions.

3. AMBLYSTEGIUM VARIUM (Hedw.) Lindb. Musc. Scand. 32. 1872.

Leskea varia Hedw. Spec. Musc. 216. *pl. 53, f. 15-20.* 1801.

Hypnum radicale L. & J. Man. 373. 1884 (not P. B.).

Plants in mats of varying density, thin and loose to almost cespitose, younger portions light green, darker below the surface; stem leaves rather close together, loosely erect-spreading, averaging 1.2 x 0.5 mm., reaching 1.4 x 0.57 mm. in large plants, broadly ovate to ovate-lanceolate, narrowed at the insertion and somewhat decurrent, *rapidly narrowed to a long and comparatively slender acumen, entire or nearly so, slightly concave but lying nearly flat when removed entire; costa strong, tapering, reaching the apex or nearly so, rarely stopping at base of acumen, leaf cells rhomboid-hexagonal, 2-4:1, somewhat rounded at the ends, toward the base becoming rectangular, subquadrate at basal margins*, those near the insertion occasionally slightly colored but not opaque; branch leaves much smaller and less slenderly acuminate. Monoicous; sporophyte little different from the preceding species but often darker and reddish. Spores in spring.

Type locality, Lancaster, Pennsylvania.

ILLUSTRATIONS.—Hedw. l. c.; Br. & Sch. Bry. Eur. *pl. 565* (As *A. radicale*); Cheney, Bot. Gaz. 24: *pl. 11, f. 10*; M. H. M. *pl. 78*.

EXSICCATI.—Sull. Musc. Allegh. 30; *Hypnum radicale*, Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 345, (Ed. 2) 524; Aust. Musc. Appal. 390 (mixed with *A. Juratzkanum*) also 373 and 376. Grout, N. Am. Musc. Pl. 136, 177a, 139 (det. Cheney) near *Hygroamblystegium irriguum*, 372 near *H. irriguum*; Musc. Perf. 82; Drumm. Musc. Am. (S. States) 143 as "*H. radicale*," approaches *Juratzkanum*, costa not percurrent in all leaves.

Common in moist shaded places on soil, at base of trees, decaying wood and even on stones, occasionally on limestone throughout our range. Exceedingly variable, particularly in size. The smaller forms simulate *A. serpens*, from which the percurrent costa distinguishes it in most cases. The larger size, shorter leaf cells and percurrent costa differentiate it from *A. Juratzkanum*. The more slender acumination and costa thinner, especially above, separate from most forms of *Hygroamblystegium irriguum*; yet there are intermediate forms between *A. varium* and each of the others that cannot be placed with certainty by any ordinary methods. One wonders whether carefully checked cultures could determine the origin of these puzzling forms.

Var. PARVULUM (Aust.) n. comb.

At first sight this is one of the most puzzling forms. The leaves are about $\frac{1}{2}$ the normal size, 0.6 mm. long, and but for the percurrent costa and more numerous quadrate alar cells, are indistinguishable from *A. serpens* or *Juratzkanum*. However, some plants in the tuft are pretty sure to show characteristic leaves.

Type, Aust. Musc. Appal. 378. *A. serpens radicale parvulum*. Undoubtedly frequent when the plants grow in an unfavorable situation.

Forma LAXUM n. f. Stem leaves distant, narrowly lanceolate, 1.2 x 0.25 mm.; leaf cells elongated, 2-3 times as long as normal, growing with more normal plants in damp shaded places, branch leaves sometimes nearly normal. Type from Valley Stream, Long Island, New York, in herb. A. J. G.; Indiana, Deam, no. 14587 is a most peculiar form growing by the borders of a lake mixed with normal plants. A hybrid? Aust. Musc. Appal. suppl. 542 as *A. serpens* var. *longifolium*. *Pl. 16, f. 10.*

Var. OVATUM Grout, M. H. M., 334. July, 1910, as forma *ovata*.

Slender, julaceous or nearly so; stem leaves smaller, 1.2–1.5 mm. long, concave, round-ovate, abruptly and narrowly short-acuminate; leaf cells shorter, 2:1; quadrate alar cells very numerous extending up $\frac{1}{2}$ the margin of the body of the leaf.

Type from near St. Louis, Missouri, N. L. T. Nelson. no. 188 in herb. A. J. G.; on rocks in swamp, Bushkill, Pa., Bartram; Aust. Musc. Appal. 377 as *A. serpens radicale subjulacum*. Pl. 16, figs. 8 a–b.

Var. LANCIFOLIUM n. var. Leaves broadly to narrowly lanceolate, tapering almost uniformly from the widest part near the base to the apex; costa strong, about 35 μ wide at base. The stem leaves at times are almost perfect triangles except for the rounded basal angles, leaves have the outline of slender *irriguum* but the costa and texture is of *varium*. It is almost the only form of the species found in Florida, where it is common everywhere on sand, decaying wood, etc. Type from base of old Gamble Mansion, Ellenton, Florida, in herb. A. J. G.; N. Carolina, Texas, Louisiana. Pl. 16, fig. 5.

My N. Am. Musc. Pl. Suppl. 11 is an aquatic form of this variety from the concrete cistern of the Gamble Mansion with the characters of forma *laxum* intensified, the stem leaves reaching 1.9 x 0.36 mm. This is a floating form of this variety of *A. varium* as the variety *longifolium* is a floating form of *Leptodictyum riparium*.

Var. ALASKANUM Card. & Thér. Proc. Wash. Acad. Sci. 4: 338. July, 1902.

"Very robust, densely branched, in broad depressed tufts, leaves very short, broadly ovate, constricted below, shortly and narrowly acuminate, alar cells much larger, inflated" From Muir Glacier (Trelease, 1752).

4. AMBLYSTEGIUM COMPACTUM (C. M.) Aust. Musc. App. 372. 1870.

Hypnum compactum C. M. Syn. Musc. Frond. 2: 408. 1851.

Amblystegium serratum Br. & Sch. Bry. Eur. Ambly. 11. 1853.

Amblystegium dissitifolium Kindb. Macoun Cat. Can. Pl. 6: 220. 1892.

Amblystegium subcompactum Kindb. l. c. 221.

Brachythecium densum Milde, Bot. Zeit. 1864: 21.

Plants about the size of *A. serpens* but variable, pale green, yellowish within the dense tufts, which may be 25 mm. deep but are usually thinner, brittle when dry; stems irregularly branching, radiculose; many radicles minutely scabrous; leaves erect-open, narrowly decurrent, often slightly secund, ovate-lanceolate and about 1 mm. long on the stems, lanceolate on the branches and smaller, gradually and evenly narrowed to the slender acumination, finely denticulate throughout on most leaves, teeth at base frequently recurved or double by the protruding angles of two adjacent cells; margins plane; costa wide, percurrent, frequently with radicles or delicate jointed brood filaments attached to the back of the costa; leaf cells linear-rhomboidal, thin-walled, 40–60 μ long, 4–10:1, shorter toward the apex, shorter and broader toward the base, at the basal angles shortly rectangular to quadrate.

"Monoicous"; seta 1–3 cm. long; capsule 1.5–3 mm. long, oblong, nearly or quite erect and symmetric, constricted under the mouth when dry and empty; operculum conic-apiculate; annulus present, cilia usually short or lacking; calyptra short, scarcely reaching below the operculum. Spores in spring apparently.

ILLUSTRATIONS.—Sull. Icon. Musc. pl. 123; Cheney, Bot. Gaz. 24: pl. 11, f. 8; M. H. M. 331.

EXSICCATI.—Drumm. Musc. Am. 188 (the type); Aust., l. c.; Grout, N. Am. Musc. Pl. 130 (a portion of some specimens is *A. serpens*), 357 & 489 (as forma *laxa*); Musci Perfecti 127, R. & C. Musc. Am. Sept. Exsic. 125.

On decayed wood, base of trees in swamps and on stones, especially limestone, occurring across the continent from New York to the Pacific coast in the Northern U. S. and southern Canada; not rare but apparently local. Not reported from New England; Arizona; N. Mexico; California.

One of the easiest species of the group to recognize but varying widely in size and compactness. The next is at best a mere subspecies. The slender branchlets at times are almost flagelliform with leaves much like those of *Amblystegiella*.

5. AMBLYSTEGIUM AMERICANUM Grout, Bryologist 13: 32. 1910.

Amblystegium Holzingeri Grout, Bryologist 12: 97. 1909. Not R. & C.

Plants growing in rather thick wide mats, light olive-green, closely allied to *Amblystegium compactum* but about twice as large, lighter colored and lacking the dense cespitose habit typical of that species; stems 2–3 cm. long, irregularly to subpinnately branching, bearing numerous multiform paraphyllia; stem leaves spreading to subsquarrose when dry, ovate-lanceolate and gradually long-acuminate, about 1.2 x 0.3–0.4 mm.,

somewhat narrowed to the insertion, strongly and longly decurrent, concave, with basal margins more or less reflexed, serrulate all around to almost entire in the larger stem leaves; costa percurrent or vanishing in the apex, stronger than in *Amblystegium compactum*; median leaf cells oblong-linear, $45-60 \times 6-10 \mu$, becoming shorter and broader toward the base; cells of basal angles subrectangular to quadrate; branch leaves smaller; minutely scabrous protonema frequent on costa of stem leaves; slender brood filaments not rare. Type from Trempealeau Ridge, Wisconsin, about ten miles south of Winona, on the Mississippi River, June 20, 1904, by Prof. J. M. Holzinger, who says this locality has produced many rare things. Type in Herb. A. J. G.; cotypes distributed as No. 335 of North American Musci Pleurocarpi. S. Dakota, McIntosh; Kamloops, B. C., MacFadden.

This is a subspecies of *Amblystegium compactum* and often has the peculiar teeth at base of leaves characteristic of that species, but its larger size, lighter color, and numerous paraphyllia, combined with several minor characters, sufficiently distinguish it.

The type collection is sterile and might easily be referred to *Brachythecium*. The brood bodies are not like any figured by Correns but I have seen similar ones on *Amblystegium compactum*.

EXSICCATI.—Grout, N. Am. Musc. Pl. 335, which is also a type duplicate. No. 17 of the supplement is an intermediate form perhaps better referred to *A. compactum*.

3. HYGROAMBLYSTEGIUM Loeske, Moosfl. d. Harz. 298. 1903.

Plants aquatic or subaquatic, usually dark or blackish green, except at the ends of the growing stems and branches, not glossy. Stems irregularly branching, sometimes with a few paraphyllia near the junction of stem and branches, central strand well developed. Leaves erect-spreading, rarely slightly secund, often with tips incurved when dry, ovate to lanceolate with plane margins, entire to slightly serrulate; costa very strong, percurrent to excurrent; leaf cells thick-walled, rhomboidal to elongate-hexagonal, shorter and broader towards the base, becoming rectangular to quadrate; often a few alar cells somewhat inflated, basal and alar cells usually thick walled and colored. Sporophyte as in *Amblystegium*.

Amblystegium and *Cratoneuron filicinum* will be sought here.

Type species *H. irriguum*.

KEY.

- | | |
|---|---------------------------------|
| 1. Leaves with the very strong costa excurrent in some or all of the leaves..... | 2. |
| Costa strong and percurrent or nearly so..... | 3. |
| 2. Leaves having excurrent costa lanceolate, others often broader..... | 1. <i>irriguum spiniforme</i> . |
| Leaves broadly oblong to triangular-ovate..... | 4. <i>noterophilum</i> . |
| 3. Leaves acute to subobtuse..... | 4. |
| Stem leaves more or less long-acuminate..... | 1. <i>irriguum</i> . |
| 4. Leaves ovate to oblong-lanceolate, costa strong, little narrowed at the rather blunt apex..... | 3. <i>fluviale</i> . |
| Leaves ovate, acute, with costa somewhat narrower..... | 2. <i>orthocladon</i> . |

1. HYGROAMBLYSTEGIUM IRRIGUUM (Wils.) Loeske, Moosfl. d. Harz. 299. 1903.

Hypnum irriguum Wils. Bryol. Brit. 361. pl. 25. 1854.

Amblystegium irriguum Br. & Sch. Bry. Eur. fasc. 55-56. pl. 566. 1853.

Hypnum fluviale of many early authors, not Swartz.

Hygroamblystegium tenax (Hedw.) Jennings, Mosses, W. Pa., 227, pl. 39. 1913.

Amblystegium serpens var. *irriguum* Aust., Musc. Appal. 375. 1870.

Plants medium-sized to large for the group, in rather wide intricate mats or in tufts, dark olive to blackish green; stems rather thick and tough with a few paraphyllia near the insertion of branches; stem leaves elongate-triangular to triangular-ovate, rather long-acuminate, "the point narrow and acute but not slender and rather rigid,"* narrowed to the insertion and slightly decurrent, ± 1 mm. long; branch leaves smaller and narrower, ovate-lanceolate to oblong-lanceolate, gradually and evenly narrowed from the widest part to the acute apex, occasionally somewhat secund, all rather thick and rigid; entire or sinuate, costa very thick and strong throughout, percurrent or merging into the apex, usually much thinner toward the apex; usually (but not always) one or more rows of basal cells enlarged and somewhat inflated; median cells elongate-hex-

* Dixon.

agonal 9-20 μ long, 2-6: 1, becoming broader, subrectangular to quadrate, thicker walled and colored near the base. Monoicous; capsule subcylindric, strongly arcuate, contracted under the mouth when dry and empty. Spores in spring.

Type English, in Herb. Wilson.

ILLUSTRATIONS.—Br. & Sch. l. c.; Wils. l. c.; Cheney, Bot. Gaz. 24: 268. pl. 12. f. 1; Jennings l. c.; M. H. M. 334.

EXSICCATI.—Aust. l. c. also 376, 379; Sull. & Lesq. Musc. Bor. Am. (Ed. 1), 347 & (Ed. 2) 526; Grout, N. Am. Musc. Pl. 139 (as *A. Juratzkanum*, probably mixed), 182, 206, 247, 328, 342; Sull. Musc. Allegh. 30 (as *Hyponum varium*).

Typically aquatic, growing on stones in streams and along the edges of streams, ponds and in swampy places. Common in northeastern U. S. and eastern Canada, west to Montana and California, south to Georgia and Arkansas. Distinguished from most plants of *Amblystegium varium* by its stronger costa, triangular-ovate stem leaves, more incrassate and colored basal cells and more aquatic habit. Intermediate forms are not rare. *H. orthocladon* has shorter and proportionately broader leaves, acute to shortly acuminate. *H. fluviatile* f. *brevifolium* is much more like *orthocladon* in these respects.

As in all aquatic and subaquatic mosses there is a great range of variation in size and leaf form. In sterile unfavorable habitats this species develops slender stems with small distant leaves; if submerged the leaves may be narrowly lanceolate, costa thinner and vanishing (var. *tenellum* Sch.) or in other cases with short ovate leaves (var. *flaccidum* DeNot). These should be regarded as mere habitat forms and not given varietal rank. The European forms of this species are described as having serrulate leaves; in American forms they are mostly entire.

Var. SPINIFOLIUM (Sch.) Grout, Check List. 14. Dec. 1929.

Stem leaves typically lanceolate with a thick excurrent costa in all the leaves but in many forms only the lower continually submerged leaves have the excurrent costa. In plate 16, f. 4a-b are shown two leaves from different portions of the same plant. Probably with the range of the species; reported from Ohio, New Jersey, Pennsylvania, Ontario.

Type locality European.

ILLUSTRATIONS.—Cheney, l. c.; M. H. M. 334; Pl. 16, figs. 4a-c.

EXSICCATI.—R. & C. Musc. Eur. Exsic. 92 (typical); Grout, N. Am. Musc. Pl. 438. (Only a portion of the leaves have the excurrent costa.)

I am led by a long series of observations to adopt Loeske's view that *Hygroamblystegium irriguum*, *H. fluviatile* and *Cratoneuron filicinum* have each developed parallel forms with a strongly excurrent costa. From *fluviatile* has come *noterophilum* and from *filicinum* has come an undoubtedly parallel European form known as *Amblystegium fallax* (Brid.)

In plants that in other respects seem to be well-characterized *irriguum* there are sometimes almost no enlarged decurrent alar cells, in others there is a well-defined basal area of larger, more or less swollen cells, usually very opaque and indistinct until cleared. Such forms seem to parallel forms of *Cratoneuron filicinum* and often have numerous paraphyllia and costa excurrent in some leaves.

Forma MARIANOPOLITANUM Dupret, M. H. M. 336, seems to be form peculiar to cool springs or similar locations. One specimen from Lanesboro, Minnesota, Holzinger, has stems 4-6 cm. long, little branching until near the top; leaves broadly ovate-oblong, shortly acuminate, reaching 2 mm. in length by 0.8 mm. wide; costa more or less excurrent; cells larger, in the lower third much larger, reaching $60 \times 15 \mu$ in size. These leaves are evidently always submerged; those of the upper stem and branches are typical for the species. Pl. 16, f. 9 a-b.

The type is from near Montreal, and N. Am. Musc. Pl. 247 may be regarded as the type. When this form branches it can in most cases be easily distinguished from the parallel forms of *C. filicinum* by the fact that in that species the branch leaves are slenderly acuminate by the excurrent costa. This form is distinguished from all forms of *H. fluviatile* by the acutely acuminate stem leaves.

This form is also known from Missouri.

*2. HYGROAMBLYSTEGIUM ORTHOCLADON (P. B.) Grout, Check List, 14. 1929.

Subspecies of *irriguum*. Plants smaller. Leaves broadly cordate-ovate, either gradually narrowed to a subobtusate apex or shortly and broadly acuminate, branches shorter; stem leaves shorter and relatively broader.

ILLUSTRATIONS.—M. H. M., 337.

EXSICCATI.—Aust. Musc. Appal. 381; Grout, N. Am. Musc. Pl. 180 and 149 (as *Amblystegium fluviatile*), Musci Perfecti 53; R. & C. N. Am. Musc. Sept. Exsic. 246. (This is near *H. fluviatile brevifolium*.)

Intermediate between *H. irriguum* and *H. fluviatile brevifolium* and often difficult to distinguish from them. Possibly better treated as a variety of the widely variable *irriguum*.

Common on stones in brooks in elevated regions of New England and probably in similar locations throughout the range of *irriguum*. Arizona, Oklahoma, N. Carolina; Minn., Conard.

Forma *BREVINERVE* n. forma. Some leaves obtuse, costa in most leaves vanishing 6-12 cells from the apex. Raleigh, N. Carolina, Blonquist; Iowa, Pennsylvania, Conard.

Dr. Conard's series from the midwest indicate that in that region the costa of *irriguum* and *orthocladon* tends to stop short of the extreme apex.

3. *HYGROAMBLYSTEGIUM FLUVIATILE* (Sw.) Loeske, Moosfl. d. Harz. 299. 1903.

Hypnum fluviatile Sw. Musc. Suec. 63, 1799.

Amblystegium fluviatile Br. & Sch. Bry. Eur. fasc. 62-64. pl. 567. 1855.

Plants aquatic, floating, with long parallel branches, dark green or blackish; stem leaves oblong-lanceolate to oblong-ovate, *not so much broader below as in most species*, scarcely narrowed to the insertion, not decurrent, *more gradually tapering to a blunt point, entire*, concave and occasionally plicate; *costa very stout, percurrent and merged into the apex, typically nearly or quite as broad above as below*; area of enlarged and rectangular cells at base larger than in the preceding, *these basal cells thick-walled and often colored, opaque or pellucid*; median and upper cells hexagonal-rhomboid, 4-6:1, or even longer, *very chlorophyllose and more or less indistinct*; capsules light reddish brown, very long, narrowly cylindric, suberect, somewhat unsymmetric but scarcely arcuate before dehiscence, after dehiscence more curved, strongly contracted under the mouth when dry. Spores in spring.

Boulay separates the species into two forms, namely f. *typicum* and f. *brevifolium*. Forma *typicum* with leaves reaching $2 \times \frac{3}{4}$ mm., oblong-lanceolate, loosely imbricate, often somewhat plicate, lower cells little colored. This form is apparently infrequent. The Bry. Eur. plate represents Boulay's forma *typicum*.

Forma *BREVIFOLIUM*, leaves oblong-ovate, $1\frac{1}{4} \times \frac{1}{2}$ mm., tapering to a wide subobtuse apex, concave, basal cells often deeply colored and opaque.

According to M. Cardot's figures of specimens supposed to be from the type locality, this is probably the typical form (see Fig. 175) and it certainly is the more common form with us. It grades into the form which M. Cardot and I believe to be *H. orthocladon* (P. B.) and which is clearly intermediate between this species and the last, merging into both with such a series of intergrading forms that it is impossible to tell where one leaves off and the other begins.

Type Swedish, in herb. Swartz, at Stockholm.

ILLUSTRATIONS.—Br. & Sch. l. c.; Cheney, Bot. Gaz. 24: pl. 12, f. 2; Jennings, Mosses W. Pa., pl. 39; M. H. M., pl. 79.

EXSICCATI.—Aust. Musc. Appal. 386; Grout, N. Am. Musc. Pl. 180. (A small form of f. *brevifolia* close to *orthocladon*, R. & C. Musc. Am. Sept. Exsic. 247 (f. *brevifolium*) also Drumm. Musc. Am. 138, as *Hypnum orthocladon*.)

On rocks and earth in and along streams. Newfoundland to Minnesota, south to New Jersey. North Carolina (f. *brevifolium*).

The shape of the leaves, the bluntish apex made up mostly of the disappearing costa and the nearly simple branches, distinguish this from the two preceding except the forma *marianopolitanum*. See distinctions under description of that form. In the field the hand-lens will usually distinguish it by its greater size but the smaller forms of f. *brevifolium* need careful microscopic study.

Var. *OVATUM* n. var. Stem leaves broadly ovate to ovate-oblong, $\pm 1.2 \times 0.6$ mm., apex broad, obtuse; costa stout reaching the apex in very few cases; branch leaves smaller, broadly ovate, costa stopping $\frac{2}{3}$ the distance from the base to apex in some cases. Sporophyte normal.

Type from "near West Chester, Pa., on stone in creek, May 15, 1904," Francis Windle. Type in herb. A. J. G. A unique and interesting form in perfect fruiting condition. Had it not been for the typical sporophyte and the costa normal in a few leaves, I should have doubted its relationship to this species. Pl. 16, f. 13.

*4. *HYGROAMBLYSTEGIUM NOTEROPHILUM* (Sull.) Warnst. Krypt.-fl. Mark. Brand. 2: 884. 1906.

Hypnum noterophilum Sull., Musc. & Hepat. U. S. 78. 1856.

Amblystegium noterophilum Holzinger, Bull. Geol. & Nat. Hist. Surv. Minn. 9: 293. Nov. 1895.

Hypnum irriguum spinifolium L. and J. Man. and others.

Subspecies of *H. fluviatile*. Plants normally the largest and coarsest of the genus, very dark dull green except at the young and growing tips, harsh and rigid, prostrate or ascending when out of water, when submerged floating, irregularly branching, often profusely so; central strand well developed, cortical cells in three or four layers, thick-walled.

Leaves of submerged plants usually oblong-lanceolate with a very thick excurrent costa, in emergent plants becoming shorter and relatively broader, ovate to broadly triangular-ovate, reaching 2.4 mm. in

length and 0.9 mm. in breadth in large plants; leaf blade very commonly of two layers of cells in the basal sixth and along the costa towards the tip, margin usually entire. Capsules produced only on plants not submerged; stomata very numerous, 90–200 to the capsule—often clustered. Otherwise much as in *H. fluviatile*. Spores in June.

Type locality, Franklin Co., Pennsylvania.* “Type in herb. Sullivant, Cambridge.”

I have referred to this subspecies plants evidently derived from both the typical form of *fluviatile* and from *f. brevifolium* and some that may possibly be more closely related to *H. orthocladon* than to either. I find numerous forms in which the strong costa is excurrent in only a portion of the leaves, usually the lower but in Sull. & Lesq. Musc. Borx. Am. (Ed. 1), no. 348 (which evidently represents Sullivant’s idea of the species) the costa is very strong and excurrent in all the leaves, which are well illustrated in Cheney’s drawings.**

ILLUSTRATIONS.—Cheney, Bot. Gaz. 24: pl. 12, f. 3; Pl. 17B.

EXSICCATI.—Sull. & Lesq. l. c.; Aust. Musc. Appal. 385 as *Amblystegium serpens irriguum noterophilum*; Grout, N. Am. Musc. Pl. 179 & 487.

In springs and small streams, especially those containing lime, across northern U. S. to Montana; Ontario; local and infrequent. N. Am. Musc. Pl. 487*** is the extreme coarse rigid form with costa nearly $\frac{1}{3}$ the width of the leaf at base and a considerable part of the lamina more than one cell in thickness. That *H. noterophilum*, *H. irriguum spinifolium* and *Cratoneuron fallax* all three have unusually large and persistent costae that often remain after the rest of the leaf has vanished and all seem inclined to be calcicolous raises the question as to whether the lime is to any extent causal of this structural peculiarity.

I have seen the type collection of *Amblystegium montanae* Bryhn (Bryologist 5: 26. 1902) and I do not think it belongs to *Hygroamblystegium*, even though it has in some ways a striking resemblance to *H. orthocladon*, because of the strongly recurved leaf margins and very thick-walled cells. I do not think it is *Leskea polycarpa paludosa* because the leaf cells are twice as long as wide.

I consider it a *Leskea*, *L. MONTANAE* (Bryhn) n. comb. The drawings accompanying the description in the Bryologist do not adequately represent the plant.

4. SCIAROMIUM Mitt. Journ. Linn. Soc. 12: 571. 1869.

This genus closely resembles *Hygroamblystegium* in appearance, habit, habitat and general structure. It differs chiefly in having the leaves bordered by a thickened margin composed of a bundle of elongated thick-walled cells; leaf cells otherwise small, short and thick-walled. Usually dioicous; sporophyte darker than is usual in *Hygroamblystegium* inclining to chestnut.

Type species *S. conspissatum* (Hook. & Wils.) Mitt.

Several species are found in S. America but we have only one.

SCIAROMIUM LESCURI (Sull.) Broth. Engler & Prantl, Musci (Ed. 1) 1030, f. 741. 1908.

Hypnum Lescurii Sull. Mosses of the U. S. 79. 1856.

Amblystegium Lescurii Jaeger & Sauerb. St. Gall. Nat. Gesell. 1877–78: 554.

Plants in loose dirty mats, dark to blackish green except for the bright green new shoots, irregularly branched; leaves thick and rather opaque, erect-spreading when moist, usually loosely appressed when dry; stem leaves broadly cordate-ovate to oblong-ovate, abruptly short-acuminate to subobtusate, subserrulate above or sometimes nearly to base, 1–1.3 mm. long; branch leaves proportionately narrower, ovate-lanceolate to lingulate, often obtuse; median leaf cells oblong-hexagonal to short-rhomboidal, 15–20 μ long, 1–3:1; basal and alar cells more or less rectangular; border of 4–5 rows of linear-flexuous thick-walled cells, gradually becoming thinner and of shorter cells toward the base and apex; costa very strong, reaching 60 μ in width, merging into the border at the apex.

Sporophyte reddish; capsule 2–3 mm. long, curved and cernuous; operculum conic-apiculate. Spores in spring.

ILLUSTRATIONS.—Sull. Icon. Musc. pl. 24; Jennings, Mosses W. Pa., pl. 39; M. H. M. 341.

EXSICCATI.—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 350.

Grout, N. Am. Musc. Pl. 150, 150a, 316. Also no. 52, issued as *Amblystegium irriguum*, contains in some packets considerable of the obtuse-leaved form of this species.

On stones in streams especially in elevated regions but found almost at sea level at Magnolia, Mass. and Cold Spring Harbor, Long Island, New York; often accompanying *Hygroamblystegium* species. Eastern U. S. and Canada, south to Georgia and Alabama, west to Ontario and western Pennsylvania.

* Cheney!

** See note under *H. irriguum spinifolium*.

*** This is from Lanesboro, Minn., not New Jersey as the label states.

In many plants the branch leaves are more obtuse than figured by Sullivant, and in the plants mixed with my 52 the stem leaves also are obtuse.

5. CRATONEURON (Sull.) Roth, Hedwigia 38: 6. 1899. (in part).

Hypnum, subgenus *Cratoneuron* Sull. Musc. & Hepat. U. S. 73. 1856.

Plants rather large, loosely tufted, bright to yellowish-green, irregularly branched to regularly pinnate, not glossy, prostrate to suberect; *stems without central strand** (except in *C. filicinum*); *paraphyllia usually numerous and of various shapes*. Leaves in most species plicate and more or less secund and decurrent; stem leaves triangular-ovate, with plane, more or less serrate margins; costa strong, frequently percurrent or even excurrent; leaf cells narrowly prosenchymatous, smooth in our species (except as noted in key); alar differentiated, often inflated and forming auricles. Dioicous; seta and capsule reddish; capsule cernuous to horizontal, cylindrical, more or less arcuate, narrowed under the mouth when dry and empty; annulus present; operculum conic-apiculate; peristome of the perfect hypnaceous type. More or less calciphile and aquatic.

Type species, *C. filicinum*.

KEY.

- | | |
|--|----------------------------------|
| 1. Leaves neither plicate nor circinate..... | 2. |
| Leaves plicate, often circinate and crispate..... | 3. |
| 2. Leaves with large decurrent auricles of inflated cells; costa usually ending in apex, rarely slightly excurrent. | 1. <i>filicinum</i> . |
| Leaves with only a few enlarged alar cells; costa strongly excurrent in most leaves..... | 1. <i>filicinum aciculinum</i> . |
| 3. Leaves more or less papillose..... | 4. |
| Leaves not papillose..... | 5. |
| 4. Stem leaves broadly deltoid, nearly or quite as broad as long; median leaf cells 4-5: 1..... | 4. <i>decipiens</i> . |
| Stem leaves elongated-triangular, 2-3: 1: median leaf cells 7-9: 1..... | 5. <i>papillosum</i> . |
| 5. Stems very radiculose; branching regularly pinnate as a rule..... | 2. <i>commutatum</i> . |
| Stems scarcely radiculose; branching irregular to subpinnate..... | 3. <i>falcatum</i> . |

1. CRATONEURON FILICINUM (L., Hedw.) Roth, l. c.

Hypnum filicinum L. Spec. Pl. 1125. 1753 and Hedw. Sp. Musc. 286. 1801.

Amblystegium filicinum De Not. Cronaca 2: 25. 1867.

Very variable in habit and size, typically rigid, ascending to suberect and regularly pinnately branched, but occurring in stout or slender irregularly branched forms, bright to dark green above, brownish below, usually densely radiculose, reaching 10 cm. in length, *paraphyllia numerous, oval, lacinate, and branched*; stem leaves cordate-triangular, 1-1.4 mm. long, 0.6-0.8 mm. wide, *slenderly acuminate, open-erect to slightly falcate-secund*; branch leaves narrower and more falcate-secund; all rigid, little changed in drying, scarcely plicate, with margins plane or nearly so, finely serrate; *costa usually percurrent* but sometimes passing beyond the apex or sometimes not reaching it; leaf cells variable, elongated-hexagonal to oblong-linear, 6-9 μ broad and 3-6: 1, usually obtuse at the ends, gradually becoming wider towards the base of leaf, *there suddenly inflated, hyaline or colored, forming clearly defined decurrent auricles*. Sporophyte as in the generic description; spores in spring.

Type locality European.

ILLUSTRATIONS.—Bry. Eur. pl. 609; M. H. M. pl. 75.

EXSICCATI.—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 317, (Ed. 2) 469.

Aust. Musc. Appal. 413; Grout, N. Am. Musc. Pl. 215, 215a, 177 & 266 as *Amblystegium varium*; 242 as *Hypnum fruitans* var.

Some specimens, apparently growing in dry situations, have the auricles less inflated and more deeply colored. Slender forms of *Thuidium paludosum* may be mistaken for this species, but its more plicate leaves with recurved margins, and the abundant filamentose paraphyllia easily distinguish it. Frequent across northern N. America, south to Alabama and New Mexico, common in many localities in rivulets and springs, preferring those containing lime. While the variations in size, habit and appearance are great,

*An unusual condition in plants having a strong costa. Such a condition also obtains in *Drepanocladus revolvens*.

the decurrent auricles of inflated and usually clear cells form an earmark that makes recognition easy. There are forms in which the alar cells are less numerous, less inflated and more deeply colored. These culminate in

Var. *ACICULINUM* C. M. & Kindb. Cat. Can. Pl. 6: 231. 1892, in which this area of cells is much reduced and colored, with thicker cell walls; costa excurrent into a rather slender point in both stem and branch leaves on most parts of the plants.

Forma *marianopolitanum* of *Hygrohypnum irriguum* approaches this variety so closely, even in the matter of inflated alar cells, that the two can scarcely be distinguished except by the fact that the branch leaves of forma *marianopolitanum* are nearly normal for *irriguum*, while those of variety *aciculinum* are mostly slender pointed with the excurrent costa.

My N. Am. Musc. Pl. 495 illustrates this variety, 291 is also a form of this variety closely approaching *H. irriguum marianopolitanum*. Musci Perfecti 177 is this variety and has the costa even stronger and more excurrent than in the type. A specimen of *Amblystegium fallax* (Brid.) Milde from Renauld and another from Mr. H. N. Dixon differ from var. *aciculinum* in having the costa as thick and strong as in *Hygroamblystegium irriguum spinifolium* but these also are evidently derived from *C. filicinum*. Specimens bearing the same name from the exsiccati of Husnot and Cardot seem to be *H. irriguum spinifolium*. I have yet to see true *fallax* from this continent.

2. CRATONEURON COMMUTATUM (Hedw.) Roth, l. c.

Hypnum commutatum Hedw. Musc. Frond. 4: 68, pl. 26. 1797 and Sp. Musc. 284. 1801.

Hypnum glaucum Lam. Fl. Fr. 1: 552. 1778.

Amblystegium glaucum Lindb. Musc. Scand. 32. 1879.

Plants in rather thick mats, bright to yellowish green, ochraceous within and often incrustated with lime; stems 4-10 cm. long, erect in thick tufts, ascending in the thinner mats, covered with a dense growth of reddish brown radicles and linear to lanceolate paraphyllia, typically with regularly complanate and pinnate branching but in American forms variable in size and manner of branching; stem leaves decurrent, broadly cordate-triangular, rapidly narrowed to a long tapering channelled acumination, falcate-secund to circinate, flexuose and more or less crispate when dry, deeply plicate with margins plane and denticulate below, and sometimes also toward the upper part, 1.5-2 mm. long; costa strong, ending in the acumination; median leaf cells oblong-linear to linear-flexuose, 35-80 μ long, 5-6 μ wide; cells broader and shorter at leaf base, subhexagonal, more or less inflated and colored or hyaline, forming decurrent auricles at the basal angles; branch leaves ovate-lanceolate, smaller and narrower; cells of some of the small branch leaves much shorter and broader.

Dioicous; seta 4-5 cm. long, reddish-brown; capsule cylindric-arcuate, cernuous, chestnut to orange-brown, 3.5-4.5 mm. long, narrowed under the mouth when dry and empty; annulus present; operculum conic. Spores in spring; rarely produced. Type locality European.

ILLUSTRATIONS.—Bry. Eur. pl. 607; M. H. M. 317; Pl. 17 I.

EXSICCATI.—Aust. Musc. Appal. Suppl. 543; Grout, N. Am. Musc. Pl. Suppl. 1; R. & C. Musc. Am. Sept. Exsic. 339.

This species often resembles *C. filicinum*, from which it may be distinguished by its plicate leaves more flexuose when dry, narrower leaf cells, and smaller area of less abruptly differentiated alar cells. From all forms of *Drepanocladus* it is readily distinguished by the profusion of radicles and paraphyllia.

Infrequent and local in the mountainous districts of the northern U. S. and Canada. Markedly calcicolous. Willoughby, Vt.; Watkins Glen, N. Y.; Newfoundland; Colorado; Wyoming. This species and its close relative, *C. falcatum*, seem frequent in the Rocky Mountains of British Columbia.

Var. *SULCATUM* (Schimp.) Broth. Engler & Prantl, Musci (Ed. 2) 2: 334. 1925.

Hypnum sulcatum Schimp. Syn. 699. 1860.

Plants extremely slender with few radicles; stem leaves smaller, about 1 mm. long, regularly falcate-secund, widely ovate and suddenly acuminate, or ovate-lanceolate; costa weaker than in typical form, usually reaching about $\frac{1}{2}$ the length of the leaf; leaf cells shorter and broader, 4-6:1. Pl. 17 K.

Doubtfully found in N. America. Waghorne's specimens from Newfoundland so labeled are a mixed lot and none which I have been able to see are this form; Berggren's Greenland specimens have not been available.

A rare alpine form found in Great Britain only on Ben Lawers and Craig Chailleadh "on wet alpine rocks."

Hypnum sulcatum var. *stenodictyon* Ren. Proc. Wash. Acad. Sci. 4: 341. 1902.

I have seen the type collection of this form. It is merely a slender form of *C. falcatum*. It has neither the short costa nor the broader leaf cells of var. *sulcatum*.

3. CRATONEURON FALCATUM (Brid.) Roth, Europ. Laubm. 534. 1905.

Hypnum falcatum Brid. Musc. Recent. 3: 63. pl. 1. f. 6. 1801.

Generally regarded as a subspecies of *C. commutatum*. Stems reaching 10 cm. in length, rarely with any noticeable regularity of branching in N. American forms; typically darker-colored than in *C. commutatum*; radicles much fewer; leaves more crowded, longer and more regularly and strongly falcate-secund, hardly flexuose when dry, relatively more slender, not cordate or triangular at base, broadly to narrowly oblong-lanceolate, less decurrent; costa very strong; median leaf cells longer, linear flexuose, typically with thicker walls. Spores in summer. Type locality European.

ILLUSTRATIONS.—Bry. Eur. pl. 608, f. β ; Braithw. Brit. Moss Fl. pl. 91; Pl. 17J.

EXSICCATI.—Grout, N. Am. Musc. Pl. Suppl. 12.

Apparently with the range of *C. commutatum* and rather more abundant in the Rocky Mts.; Willoughby, Vt.; Owen Sound, Ontario; Idaho; Newfoundland; Alaska.

On the sides of Ben Lawers in Perthshire, Scotland, *C. commutatum* and *C. falcatum* were growing side by side without showing any very apparent intergrading, which leads me to believe that *falcatum* is better than a variety of *commutatum*.

A very slender form from Middle Arm, Newfoundland, Oct. 29, 1898, labeled as *Hypnum subsulcatum* Schimp., is very close to var. *graciliscens* Schimp., which differs from the type mainly in its reduced size throughout.

Hypnum falcatum var. *microphyllum* Kindb. Cat. Can. Pl. 6: 232. 1892 is a variety of *Drepanocladus Sendtneri*.

4. CRATONEURON DECIPIENS (De Not.) Loeske, Moosfl. d. Harz, 311. 1903.

Thuidium decipiens De Not. Epil. Bry. Ital. 233. 1869.

Plants with the appearance of a slender form of *C. commutatum*, from which it differs as follows: stem leaves very broadly deltoid, often broader than long, suddenly contracted to the insertion, rather slenderly acuminate; median leaf cells elliptic-hexagonal, 7–8 μ wide, 4–5: 1; cells of all leaves markedly papillose, especially toward the base.

ILLUSTRATIONS.—Braithw. Brit. Moss Fl. pl. 91; Dixon & Jam. Handb. Brit. Mosses (Ed. 3) Pl. 58H; Pl. 17H.

Frequent in Europe but doubtfully occurring in N. America, as all the available material has proved to be something else.

5. CRATONEURON PAPILLOSUM n. sp.

Plants in deep loose masses, yellowish green; stems slender \pm 7 cm. in length, subpinnately branching, with branches short or lacking on the lower part of the stem and clustered above, unequal in length; paraphyllia numerous, slender, filiform from a narrow base, often subserrulate on the margins; radicles abundant on stem and base of leaves; leaves falcate, more or less secund especially at tips of stems and branches; stem leaves elongated triangular-ovate, about 2 x 0.75 mm., plicate, channelled at apex, somewhat flexuose; finely and sharply denticulate at base and more or less serrulate all around; costa strong, extending into apex; leaf cells, especially those near the leaf base, papillose on both sides with low papillae from the cell angles; median cells 5–6 x 45 μ ; basal cells much as in *C. commutatum*; branch leaves smaller, narrower, more crispate and only slightly papillose. Sporophyte unknown.

Type from Columbia Falls, Montana, Oct. 10, 1895, R. S. Willaims no. 411. Type in herb. N. Y. Bot. Garden. Cotypes in herb. R. S. Williams & herb. A. J. G.

ILLUSTRATIONS.—Pl. 17A, f. 5–9.

Verdoon's Bryoph. Ard. Exs. 26 as *C. commutatum* var. *Janzenii* Loeske is a form of this species, a form regularly and evenly pinnately branched, with papillae rather less numerous than in the type. I collected a plant on Ben Lawers in Scotland in 1930 that, although referred to *commutatum*, has its leaves evidently papillose and is much nearer this species than *decipiens*. The European plants are dark to brownish green.

This species appears like very slender *commutatum* but the papillose leaves are less secund. It differs from *C. decipiens* in its leaves nearly three times as long as broad and in its much narrower and longer leaf cells.

✓6. CAMPYLIUM (Sull.) Mitt. Journ. Linn. Soc. 12: 631. 1869.

Hypnum. subgenus *Campylium* Sull. Mosses U. S. 77. 1856.

Plants slender, rarely robust, growing in moist places, frequently in or near water, usually over earth or stones (except *C. hispidulum*). This genus is closely allied to *Amblystegium*, from which it differs in the longer, oblong to linear leaf cells, and typically squarrose to squarrose-recurved leaves (except *C. polygamum*

and *C. radiale*) with acumination usually channelled. Branching usually irregular. Central strand of few cells. Paraphyllia rarely present. The leaves are rarely secund, almost never falcate-sekund, never circinnate, broadly ovate to lanceolate, plane-margined (except *C. Halleri*) and entire or serrulate, usually long-acuminate and decurrent; alar cells somewhat differentiated, quadrate to hyaline-inflated. Costa single in some species, in others short and double or lacking, never percurrent or excurrent. Usually dioicous. Capsules inclined to horizontal, curved and usually contracted under the mouth when dry and empty; annulus present; peristome of the perfect hypnaceous type. Type species, *C. hispidulum*.

KEY.

- | | |
|--|---|
| 1. Leaves with a well developed single costa..... | 2. |
| Leaves with costa short, double or wanting..... | 5. |
| 2. Leaves not squarrose, sometimes widely spreading..... | 3. |
| Leaves markedly squarrose..... | 4. |
| 3. Stem leaves cordate-ovate, abruptly and slenderly acuminate..... | 9. <i>radiale</i> . |
| Stem leaves broadly lanceolate, gradually narrowed to a very long and slender acumination..... | 8. <i>polygamum</i> . |
| 4. Leaves ovate-lanceolate, abruptly narrowed to the long slender acumination; costa simple, reaching the middle of the leaf or beyond..... | 7. <i>chrysophyllum</i> . |
| Leaves broadly ovate, abruptly narrowed to a much shorter recurved acumination; costa shorter and usually forking..... | 5. <i>Cardoti</i> . |
| 5. Plants slender; alar cells not conspicuously enlarged or inflated (except <i>C. Treleasei</i>); paraphyllia few (except varieties of <i>C. Halleri</i>); monoicous..... | 9. |
| Plants more robust; alar cells usually conspicuously enlarged or inflated; paraphyllia none; dioicous..... | 6. |
| 6. Leaves gradually long-acuminate..... | 3. <i>stellatum</i> . |
| Leaves abruptly acuminate from a broadly ovate to cordate-ovate base..... | 7. |
| 7. Costa often reaching the middle..... | 5. <i>Cardoti</i> . |
| Costa seldom reaching even $\frac{1}{3}$ length of leaf..... | 8. |
| 8. Leaves short-acuminate..... | 6. <i>arcticum</i> . |
| Leaves long and slenderly acuminate..... | 3. <i>stellatum</i> var. <i>protensum</i> . |
| 9. Leaves squarrose..... | 10. |
| Leaves subimbricate, sometimes somewhat secund..... | 4. <i>Treleasei</i> . |
| 10. Leaves strongly squarrose-recurved, most strongly serrate at apex..... | 2. <i>Halleri</i> . |
| Leaves squarrose, moderately or not at all recurved, most strongly serrate at base..... | 1. <i>hispidulum</i> . |

Leptodictyum trichopodium Kochii and *Amblystegium Juratzkanum* may be sought in this genus as they have spreading leaves, but their leaves are spreading from the base and not bent, consequently they will lie flat on the slide when mounted while the species of *Campylium* likely to be confused with them will not. *Plagiothecium striatellum* has the appearance of this genus because of its squarrose leaves, but the leaves are markedly serrate, ecostate; stem without central strand and capsules strongly striate when dry.

1. CAMPYLIUM HISPIDULUM (Brid.) Mitt. Journ. Linn. Soc. 12: 631. 1869.

Hypnum hispidulum Brid. Spec. Musc. 2: 198. 1812.

Plants slender, interlaced in bright green tufts; stems creeping, irregularly branching; stem leaves reaching 0.8 mm. long, widely spreading to squarrose, triangular-cordate, rather abruptly narrowed to an acumination which varies in length from 1 to 1.5 times the length of the body of the leaf, somewhat concave, subserrulate all around, more strongly so at base, decurrent, excavate; costa nearly or quite lacking; median leaf cells about 6 μ wide, 3-6 : 1; basal cells shorter; differentiated alar cells numerous, subrectangular to quadrate, 9-12 μ in width; branch leaves similar, less broadly ovate and less abruptly acuminate; perichaetial leaves oblong-lanceolate, sheathing, reaching 1.5 mm. in length. Monoicous; seta 1.5-2.5 cm. long, chestnut to yellowish; capsule small, oblong, more or less curved and cernuous, yellowish brown, often darker with age; operculum conic-apiculate; annulus simple; peristome perfect. Spores in late spring.

Type locality, Pennsylvania.

On bases and roots of trees, decaying wood and humus on or near the ground in moist shaded places. Common in northeastern U. S. and eastern Canada, especially in cool elevated regions; south to N. Carolina,

Alabama, Missouri, and Texas; west to Idaho and British Columbia. The leaves vary greatly in the width of the basal part and in length and slenderness of acumination. The narrow-leaved forms culminate in var. *Sommerfeltii* and the broad-leaved forms in var. *cordata*.

ILLUSTRATIONS.—Sull. Icon. Musc. pl. 199; Jennings, Mosses W. Pa. pl. 41; M. H. M. 322.

EXSICCATI.—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 341; Sull. Musc. Allegh. 37; Aust. Musc. App. 392; Grout, N. Am. Musc. Pl. 185; R. & C. Musc. Am. Sept. Exsic. 331.

Var. *SOMMERFELTII* (Myr.) Lindb. Contr. ad Fl. Crypt. As. Bor. 279. 1872.

Hypnum Sommerfeltii Myr. Vet. Akad. Årsb., Stockholm, 1831: 328.

Very slender; stem leaves more narrowly cordate-ovate at base; acumination very long and slender, reaching twice the length of the body of the leaf; leaf cells typically rather longer, differentiated alar cells fewer in number, sometimes colored; paraphyllia occasional as in the species. Pl. 17 A.f. 2. Dixon says "On calcareous soil principally."

Specimens collected by Miss Leonard near Boulder, Colorado are practically identical with the European form which is the type of this variety; Oklahoma, comm. Conard.

EXSICCATI.—Aust. Musc. App. 393 from the White Mts. is near this variety; Michigan; New Brunswick to British Columbia in Canada. See Macoun, Cat. Can. Pl. 6: 223.

Var. *CORDATUM* n. var. Plants stouter, branches short, erect and crowded like coarse velvet pile; leaves crowded and almost sheathing, almost exactly cordate, 0.6 by 0.72 mm., more strongly serrulate; abruptly and more shortly acuminate; acumination squarrose-spreading; body part of leaf often broader than long; paraphyllia more abundant, larger, multiform, often almost lacinate with long projecting cells; median cells shorter, 6 μ wide; quadrate and rectangular alar cells much more numerous, extending almost to costa at base and up the margin to the widest part of the leaf; traces of a very short, rather wide costa present in most leaves. Capsules small, 1.5 mm. long. Type from Moore's Spring, near Winston-Salem, N. Carolina, on decaying stumps, P. O. Schallert. Type in herb. A. J. G. Pl. 17A. f. 1.

This is the culmination in variation of the "forma compacta"* described on p. 323 of M. H. M. "Apparently growing in drier places, it has its leaves closer together and branch leaves shorter-acuminate and more strongly serrulate and leaf cells shorter than figured by Sullivant." This form is not uncommon but the type of var. *cordatum* is unlike anything else I have seen. If the latter turns out to be a constantly recurring form it should be raised to specific rank as *CAMPYLUM CORDATUM*. Its capsules were operculate in August but have an undeveloped appearance and there was evidence that the sporophytes were infested with a fungus, but the plants as to stems and leaves seemed unusually healthy and vigorous.

2. *CAMPYLUM HALLERI* (Sw., Hedw.) Lindb. Musc. Scand. 38. 1879.

Hypnum Halleri Sw. Meth. Musc. 34. 1781 and Hedw. Sp. Musc. 279. 1801.

Hypnum Macounii Kindb., Macoun Cat. Can. Pl. 6: 224. 1892.

Campylophyllum Halleri Fleisch. Hedwigia 47: 195. 1907.

Plants intertangled in dense but thin mats, bright green to brownish; stems rather irregularly or sub-pinnately branching, prostrate; leaves crowded, squarrose-recurved; stem leaves reaching 1 mm. in length, ovate to deltoid-ovate, narrowed more gradually to the shorter acumination than in the last, concave, narrowed to the insertion, slightly decurrent, not excavate; margins entire and slightly recurved below, plane and serrulate above; median leaf cells oblong-linear, 30-40 \times 5 μ ; area of quadrate to oblong alar cells small; costa entirely lacking in most cases; branch leaves smaller and narrower. Autoicous; capsules small, about as in *C. hispidulum*, oblong-cylindric, curved and cernuous; annulus simple.

Type locality European. On earth and rocks; British Columbia, Newfoundland, Montana. Rare; occasional in the Rocky Mountain region. Most American plants differ from most European *Halleri* in having the leaves less crowded, more decurrent and less strongly recurved, with more numerous and clear quadrate alar cells. The leaves are also more narrowed to the insertion with lower margin nearly entire. In nearly all of these particulars they are closely approached by specimens collected on Ben Lawers in Scotland.

After a study of these forms it seems a needless and unwarranted multiplication of genera to make a separate genus for *C. Halleri*.

ILLUSTRATIONS.—Bry. Eur. pl. 581; Pl. 18.

EXSICCATI.—Drumm. Musc. Am. 191; R. & C. Musc. Am. Sept. Exsic. 332.

* *Hypnum byssirameum* C. M. & K. is this form. The type in the Kindberg Herbarium has been examined.

3. *CAMPYLUM STELLATUM* (Schreb., Hedw.) Lang. & C. Jens. Consp. Fl. Groenl. 328. 1887.

Hypnum stellatum Schreb. Spic. Flor. Lips. 92. 1771, and Hedw. Sp. Musc. 280. 1801.

Plants the most robust of the genus, bright to yellowish golden-green, in rather thick tufts or mats; stems stout, irregularly branching, erect to ascending, 5–10 cm. long; leaves 1.5–3 mm. long from a *widely ovate or triangular-cordate base, gradually or rather abruptly narrowed to a long tapering channelled acumination, spreading to squarrose*, usually entire at base, somewhat excavate with rounded scarcely decurrent auricles; *costa lacking or occasionally present* and thin or forking; median leaf cells $\pm 45\text{--}75 \times 6 \mu$, narrowly linear, becoming thicker-walled and porose in older leaves; *alar cells subrectangular, enlarged, pellucid or colored, conspicuous*. Dioicous; seta 2–3.5 cm. long; capsule brown to chestnut, oblong-cylindric, curved and cernuous, $\pm 3 \times 1$ mm., usually contracted under the mouth when dry and empty. Spores in *spring*. All the authorities say summer, but in the specimens I have examined all capsules collected after June 1st were deperculate. Capsules are sparingly produced and most collections are sterile.

ILLUSTRATIONS.—Bry. Eur. *pl.* 584; Jennings, Mosses W. Pa. *pl.* 42; M. H. M. *pl.* 77.

EXSICCATI.—Drumm. Musc. Am. 184; Sull. Musc. Allegh. 35; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 339, (Ed. 2) 515; Aust. Musc. Appal. 399; Grout, N. Am. Musc. Pl. 290 & 373; R. & C. Musc. Am. Sept. Exsic. 334.

While apparently preferring cool bogs, this has been collected at Hyannis, Mass. in a marsh opening into salt water. Northern U. S. and Canada; ranging west to the Rocky Mts., Colorado, British Columbia and Alaska; south to Pennsylvania and Ohio in the East.

Not abundant but widely distributed.

Var. *PROTENSUM* (Brid.) Roehl. (M. H. M. 327).

Hypnum protensum Brid. Musc. Rec. 2^o: 85. *pl.* 2. f. 3. 1801.

Plants slender, more elongate and prostrate; leaves more distant, smaller, more abruptly narrowed from a distinctly cordate-ovate base to a longer and more slender acumination. *Pl.* 17A. f. 3.

EXSICCATI.—Grout, N. Am. Musc. Pl. 352.

Apparently with the range of the species but much less frequent. North American forms are best treated as a variety of *stellatum*. This variety bears about the same relation to *stellatum* that var. *Sommerfeltii* bears to *C. hispidulum*.

European authors seem agreed that *C. stellatum* and *C. chrysophyllum* are very close to each other and have intermediate forms. This does not seem true in N. American plants.

*4. *CAMPYLUM TRELEASEI* (Ren.) Broth. Engler & Prantl, Musci (Ed. 1) 1043. 1909.

Hypnum Treleasei Ren. Proc. Wash. Acad. Sci. 2: 338. *pl.* 22, fig. 5a–e. 1900.

Densely cespitose, fragile, yellowish green; stems short, 2–3 cm. long, erect, radiculose below; branches fastigiate, erect, *outer layer of cells of stem and branches large and hyaline*; leaves close together, *subimbricate*, sometimes slightly secund, small, 1.2×0.6 mm., ovate-lanceolate, *rather shortly acuminate, usually minutely denticulate*, concave, not plicate, subclasping and narrowly decurrent at base; costa short and double or wanting; *median leaf cells 30–40 μ , rarely 60 μ long, 6–7 μ wide, growing broader and shorter toward the base; at basal angles a group of dense, subquadrate cells* and below these a number of hyaline inflated cells (not well shown in illustration) form small decurrent auricles. Sporophyte unknown.

Type from St. Matthews Island, Alaska. Trelease 2158 and 2865.

Cotype seen at the N. Y. Botanical Garden and also another from the Missouri Botanical Garden.

A form from Virgin Bay, Juneau, Alaska, has longer more slenderly acuminate leaves with longer and narrower cells.

This is clearly a subspecies of *C. stellatum*, distinguished by its smaller size and the characters italicised in its description.

The description and drawings are based on the St. Matthews specimens. *Pl.* 18. fig. 5a–e.

*5. *CAMPYLUM CARDOTI* (Thér.) Broth. Engler & Prantl, Musci (Ed. 1) 2: 1043. 1909.

Hypnum Cardoti Thér. Bot. Gaz. 30: 125. *pl.* 11, f. 4. 1900.

Plants olive-green, soft, lax, depressed-cespitose; stems creeping or ascending, 2–4 cm. long, irregularly branching; leaves rather distant, squarrose-spreading, sometimes subsecund, broadly deltoid-ovate, narrowed at base and decurrent, above rapidly narrowed to a *rather short narrow recurved acumination*, about 1.5×0.75 mm.; margins plane, *sinuate-dentate* nearly the whole length; *costa single and forking, reaching the middle of the leaf or shorter and double*; median leaf cells linear, subflexuose; basal shorter

and broader; alar lax, larger, subhyaline; outer perichaetial leaves ovate-lanceolate, shorter-acuminate, subentire, ecostate; the inner plicate and costate. Polygamous; seta reddish; capsule about 1.8 cm. long, oblong, arcuate and subhorizontal; operculum convex-apiculate. (Translated from the original description.) "This species should be considered a subspecies of *stellatum*" from which it is distinguished by the polygamous inflorescence and the softer leaves with a shorter acumination and the "looser areolation."

Avalanche Basin, northern Montana, Holzinger. *Pl. 18. figs. 4a-d.*

6. *CAMPYLUM ARCTICUM* (Williams) Broth. Engler & Prantl, Musci (Ed. 2) 2: 336. 1925.

Chrysohypnum arcticum Williams, Rep. Can. Arctic Expd. 4: 106. *pl. 15e, figs. 13-18.* 1921.

Stems short, 1-2 cm., pale yellowish, without radicles and with few irregular branches; central strand small and two outer layers of stem cells usually with thickened walls; stem leaves appressed at base, broadly ovate, subclasping, *very concave, not decurrent*, reaching 1.7-2 x 1.4 mm., *suddenly contracted into an acute widely spreading acumination*; margins entire, and plane or incurved below; costa mostly short and double, or rarely single and usually slightly forking above, rarely extending up $\frac{1}{2}$ the leaf; branch leaves narrower, very concave, mostly ecostate or with very short costa; median leaf cells pale, thin-walled, 25-40 x 7-8 μ ; basal cells often with somewhat thickened and golden brown walls, *broader and shorter than those above and extending to the costa, the alar rarely forming a rather distinct, somewhat inflated cluster.* Sterile, no archegonia or antheridia found.

(Adapted from the original description.)

"Type locality, swamp on Pihumalerksiak Island off Cockburn Point, Dolphin and Union Strait, Northwest Territories, July 15, 1916, F. Johansen." Type seen, a very distinct species.

"This species seems to come nearest to *C. stellatum* but the leaves are relatively much broader below" and much more shortly acuminate, "the cells about twice as broad in proportion to their length, with the cell walls thinner throughout and not pitted." *Pl. 18. figs. 13-18.*

7. *CAMPYLUM CHRYSOPHYLLUM* (Brid.) Bryhn, Expl. 61. 1893.

Hypnum chrysophyllum Brid. Musc. Rec. 2^o: 84. *pl. 2, f. 2.* 1801.

Hypnum polymorphum Hook. & Tayl. Musc. Brit. 107. 1818.

Hypnum uncostatum C. M. & Kindb. Macoun Cat. Can. Pl. 6: 224. 1892.

Hypnum sinuolatum Kindb. Hedwigia, 1897: 47 (Type seen).

Hypnum subsecundum Kindb. Rev. Bryol. 22: 87. 1895 (Type seen).

Plants slender, creeping, irregularly and diffusely to subpinnately branching, forming thin loose mats in some cases, in others cespitose; leaves squarrose-spreading from a somewhat clasping base, occasionally somewhat secund in varietal forms; stem leaves ovate to ovate-lanceolate, decurrent, rather abruptly narrowed to a long slender, somewhat channelled acumination, $\pm 1.5 \times 4.5$ mm., typically entire or slightly denticulate at base; branch leaves narrower, lanceolate to ovate-lanceolate; costa single, reaching the middle of the leaf or beyond; leaf cells 5-9 μ wide, 4-6 : 1; a small group of alar cells shorter and subquadrate. Dioicous; capsule oblong-cylindric, curved and cernuous, reaching 3.5 mm. in length, contracted under the mouth when dry and empty; operculum conic-apiculate; annulus present, of more than one row of cells; peristome perfect. Spores in spring to early summer.

ILLUSTRATIONS.—Bry. Eur. *pl. 583*; Jennings, Mosses W. Pa. *pl. 41*; M. H. M. 323.

EXSICCATI.—Drumm. Musc. Am. 185, 186; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 340, (Ed. 2) 516; Sull. Musc. Allegh. 36; Aust. Musc. Appal. 397, 398; Grout, N. Am. Musc. Pl. 314, 320 & 334; R. & C. Musc. Am. Sept. Exsic. 333. Austin's 398 has strongly secund leaves and was called by him "*var. uncinifolium*."

Common in northeastern N. America; south to Georgia and Texas, west to New Mexico, Arizona, Minnesota and British Columbia. Growing over earth, stones and humus in moist places. It varies greatly in robustness and density of tufts, length of costa, length and slenderness of acumination, spreading of leaves, serrulation of margin and size of capsule.

We have forms of *chrysophyllum* with the costa short in some of the leaves and forms of *stellatum* that have a costa reaching nearly to the middle of the leaves but these are infrequent. In these intermediate plants the costa often varies greatly in the leaves of the same plant.

We have forms of *chrysophyllum* that are practically identical with the European plant, yet by far the greater number of plants that I have examined have branch leaves with a broader and rather shorter acumination, which is sinuate to subserrulate, having leaf cells rather broader in proportion to their length. The

very young leaves are often serrate at apex. These forms culminate in var. *brevifolium* and I have named them f. INTERMEDIUM Grout, M. H. M. 324.

Hypnum unicastatum C. M. & K. of Macoun's Can. Musci 840, 132 of my N. Am. Musc. Pl. and Austin's Musc. Appal. 394 and 395 are this form.

Var. BREVIFOLIUM (R. & C.) Grout, M. H. M. 324. 1910 (var. *carolinianum* Grout, Bryol. 11:29. 1908). *Hypnum chrysophyllum brevifolium* R. & C. Bull. Herb. Boiss. 4: 19. 1896.

Very robust; leaves often more or less falcate, somewhat secund in the type, more gradually and less slenderly acuminate, many plainly serrulate at apex. N. Am. Musc. Pl. 313. Apparently more frequent southwards.

The type of *Hypnum subsecundum* Kindb., from Newfoundland, Waghorne, is a form of *chrysophyllum* having the upper leaves secund and somewhat falcate, more erect than in the typical form; basal and alar colored, the median rather narrower. All the specimens in Kindberg's herbarium that were not cited with the original description were forms of *chrysophyllum* having upper leaves secund. (One exception was a depauperate *Drepanocladus uncinatus*.) The Credit Forks, Ontario, specimen cited by Macoun was ordinary *chrysophyllum* with upper leaves a little secund.

Var. ZEMBLIAE Jens.

Campylium zemblae Jens. Meddel om Groenl. 3:322. 1887.

Chrysohypnum polygamum zemblae (Jens.) Moenkem. Laubm. Eur. 718. 1927.

Pale yellowish-brown, a few centimeters in length, \pm erect, irregularly branching; leaves narrowly acuminate from a cordate base, entire, acute, spreading or the branch leaves somewhat secund; costa reaching the middle of the leaf or longer, or shorter and forked; leaf cells in the lower half short and broad, subrectangular; upper leaf cells longer and narrower; alar larger, rectangular, hyaline or brownish-yellow. Greenland, also Spitzbergen, Nova Zembla.

Cotype seen through the courtesy of Dr. C. Jensen. The specimen was from Nova Zembla, Aug. 1882, collected by Th. Holm. It seems to the writer to be undoubtedly a form of *C. chrysophyllum* having its leaves rather more slender than usual, 0.35×1.3 mm.

8. CAMPYLIIUM POLYGAMUM (Br. & Sch.) Bryhn, Expl. 61. 1893.

Amblystegium polygamum Br. & Sch. Bry. Eur. fasc. 55-56. pl. 572. 1853.

Hypnum polygamum Sch. Syn. 604. 1860.

Plants loosely to densely caespitose, yellowish to dark or golden green; stems creeping to ascending, 2-8 cm. long, irregularly branching; stem leaves erect-spreading, not squarrose, not crowded, entire, broadly lanceolate, occasionally ovate-lanceolate, $2-2.5 \times 0.8$ mm., gradually and evenly tapering to a long channelled acumination, rounded at the clasping base; costa single, variable but usually reaching at least $\frac{1}{2}$ the length of the leaf, distinct but not strong; median leaf cells narrowly linear and somewhat flexuose, thin-walled except when old, $\pm 7 \mu$ wide and $8-12 : 1$ (Limpricht says $10-15 : 1$); branch leaves similar but smaller; enlarged basal cells reaching nearly to the costa; the alar inflated and often colored, forming distinct auricles; inner perichaetial leaves reaching 4 mm. in length, entire, plicate, costa ending before the apex. Polygamous; seta 2-4 cm. long, reddish brown; capsule with a short erect neck, oblong-cylindric, curved and cernuous, brown, turning chestnut with age, $\pm 2.5 \times 0.8$ mm.; operculum conic-apiculate; annulus present; peristome perfect. Spores spring to early summer.

ILLUSTRATIONS.—Bry. Eur. l. c.; Jennings, Mosses W. Pa. pl. 42; M. H. M. 326.

EXSICCATI.—Aust. Musc. Appal. 401; Grout N. Am. Musc. pl. 430.

Swamps and wet meadows, northern U. S. to arctic N. America, south to New Jersey, Pennsylvania and Virginia. The costa is frequently short and double in some leaves and well developed on others of the same plant. Occasional forms are found with some of the leaves broadly ovate at base with almost the outline of forms of *C. stellatum*, which it approaches on one hand in its larger forms with somewhat variable costa. On the other hand in its smaller forms with more spreading leaves it approaches *C. chrysophyllum*, but is easily distinguished by the inflated alar cells. These smaller forms culminate in a form close to the European var. *minus*.

Var. MINUS (Sch.) n. comb.

Hypnum polygamum var. *minus* Sch. Syn. (Ed. 1) 604. 1860.

Plants about the size and appearance of *C. radiale* but distinguished by the longer and narrower leaf

cells and the less abruptly acuminate leaves. This form seems frequent in Florida and probably is the southern representative of the species.

EXSICCATI.—Grout, N. Am. Musc. Pl. 371, 275 issued as *C. chrysophyllum* and reported later as *C. radicale*. Dr. Best in naming 371 said, "Approaching var. *minus* (Sch.). var. *minus* seems scarcely distinguishable from *Amblystegium hygrophilum* (Jur.). The leaf cells are, however, longer narrower and more flexuose." After a great deal of hesitation I have decided to accept Dr. Best's point of view. This variety is about $\frac{1}{2}$ the size of the typical form and has more widely spreading leaves. It is really a connecting link between *C. polygamum* and *C. radicale* and seems to me to show clearly that the affinities of the latter are with *Campylium* rather than *Amblystegium*.

Var. LONGINERVE (R. & C.) Grout n. comb.

Hypnum polygamum longinerve R. & C. Bot. Centralbl. 44: 423. 1890.

Campylium polygamum longinerve (R. & C.) Grout N. Am. Musc. Pl. List, nos. 1-400. 1912.

Plants with the appearance of a large form of *C. polygamum* but with terminal leaves occasionally somewhat secund; leaves very long and narrow, stem leaves reaching more than 3 mm. in length and less than 0.6 mm. wide with slender apex more deeply channelled than in typical forms; alar cells less conspicuously enlarged and differentiated cells fewer in number, scarcely forming auricles; leaf cells longer and narrower than is usual in *C. polygamum*; costa strong in all leaves, percurrent to excurrent into a slender filiform point; inner perichaetial leaves long-lanceolate with a wide excurrent costa, serrate above just below where the lamina ceases. Monoicous; seta \pm 2 cm. long, red-brown; capsules about 3 mm. long, brown, cylindric-arcuate and cernuous; peristome perfect; spores in spring.

Type locality, Victoria, Vancouver Island.

Described from N. Am. Musc. Pl. 208 from Seattle, Washington, which was identified by Renaud himself.

Distinguished from *Drepanocladus aduncus capillifolius* by the strongly channelled apex and the less conspicuous alar cells. The Seattle plant is so near *D. aduncus capillifolius* that I incline to the view that this variety should rather be referred to that plant.

Var. FLUITANS n. var.

Plants floating, yellow-green; leaves squarrose spreading, somewhat shriveled in drying, broadly ovate-lanceolate with acumination shorter than in typical forms; costa 60μ wide at base, often forking; walls of leaf cells thicker, about 2μ ; median leaf cells $7-8 \times 25-45 \mu$. Type floating in ponds, Gray Eagle Valley, Plumas Co., California, Sept. 1900. Alt. 6500 ft. J. B. Leiberg, No. 5495. Pl. 17A, f. 4.

Type in herb. N. Y. Botanical Garden.

9. CAMPYLIUM RADICALE (P. B.) Grout, Bryol. 12: 96. 1909.

Hypnum radicale P. B. Prod. 68. 1805. Not *Amblystegium radicale* Br. & Sch.

Hypnum bergenense Aust. Musc. Appal. 391, 18. 1870.

Hypnum hygrophilum Jur. in Rabenh. Bryoth. Eur. no. 649. 1869.

Hypnum chrysophyllum var. *tenellum* L. & J. Man., not Br. & Sch.

Hypnum decursivulum C. M. & Kindb. Macoun, Cat. Can. Pl. 6: 224. 1892. Type seen.

Plants slender, lax, little branched, in very thin network over decaying leaves, humus, etc.; stem leaves distant, not squarrose but widely spreading, nearly or quite entire, resembling those of *C. chrysophyllum* but with more enlarged alar cells, $\pm 0.7 \times 1.3$ mm., broadly cordate-ovate and somewhat decurrent, subclasping and excavate at base so that the leaves will not lie flat when removed and mounted; apex somewhat channelled; median leaf cells thin-walled, hexagonal-linear, $\pm 7.5 \mu \times 30-45 \mu$; alar cells rather abruptly enlarged, hyaline or nearly so; costa well developed, reaching the middle or beyond. Seta reddish brown ± 4 cm. long; capsules light brown, 2-2.5 mm. long, 3-4 : 1, cernuous and arcuate, contracted under the mouth when dry and empty. Spores in early spring.

ILLUSTRATION.—M. H. M. 337.

Type locality, North America. Type in herb. Schwaegrichen. Probably frequent in the eastern U. S. and Canada, but not readily recognized; south to Florida.

Distinguished from all species of *Amblystegium* by the leaf bases as described above and the channelled acumination; from *C. chrysophyllum* in the lax habit of the little branched plants with distant, non-squarrose leaves and inflated alar cells.

Loeske, Hedwigia 51: 286-298, disagrees with the contention that this plant is the same as *Hypnum*

hygrophilum Jur. He is correct in saying that the latter is monoicous, so also is *H. bergenense*, Aust. Musc. Appal. 391, as Austin plainly states on his label "(parasitico-monoica)."

The statement in my key M. H. M. 321, that *Campylium radicale* is dioicous is an error, the occurrence of which I cannot satisfactorily explain to myself.

Whatever may be the theoretically correct name of the plant, I am sure that no. 345 of the Bry. Silesica of Limpricht is practically identical with Austin's 391 and that both represent a species of frequent occurrence in eastern N. America, distinguishable from *C. chrysophyllum* as noted above and from *Leptodictyum trichopodium Kochii* (to which Loeske compares it) by the narrower leaf cells and the inflated alar cells, similar to those in *C. stellatum* but rather less conspicuous. Plants of this species collected near Montreal by Dupret have a rather faint costa not reaching to the middle of the leaf and alar cells less abruptly differentiated.

Loeske thinks *Hypnum hygrophilum* is polyphyletic. This may very well be, but one of its components at least seems to me to be clearly the same as Austin's *Hypnum bergenense* and probably, but less certainly the same as *Hypnum radicale* P. B.

Campylium pseudocomplexum (Kindb.) Broth. l. c.; *Hypnum pseudocomplexum* Kindb. l. c. 85.

"Leaves small, neither circinate nor distinctly recurved, not appressed when dry; inner basal cells yellow (at least on the stem leaves) and oblong, the angular suboval, small and not well defined; costa indistinct or short and double. Stem leaves ovate or ovate-oblong, short-acuminate and nearly straight. Branch leaves ovate-lanceolate, longer acuminate, often falcate. Tufts dense and pale green. Stem irregularly divided, not radiculose. Resembles a variety of *H. molluscum* in the habit. Capsules not found. Dioecious."

"America, Arctic district. Alaska: J. M. Macoun."

No plants of this species have been available. Not only the species but its systematic position is doubtful.

7. HYGROHYPNUM Lindb. Act. Soc. Fenn. 10: 277. 1872.

(*Limnobium* of the Bry. Eur. and Mitten is antedated by a genus of flowering plants.)

Plants aquatic, growing on stones and rocks in streams, rarely in bogs or on wood; main stems procumbent with ascending branches, not radiculose, often defoliate below, irregularly and sparingly branched; central strand usually present; pseudoparaphyllia found only at the insertion of the branches; stem and branch leaves little different, often somewhat secund, mostly short and broad, usually soft, obtuse and rounded, sometimes apiculate or shortly pointed, rarely acuminate and acute, more or less decurrent, usually entire; costa in most cases short and double, or longer and forked, in a few species mostly single and reaching the middle of the leaf or beyond. The costa not infrequently occurs in all these different forms in the leaves of the same plant. Alar cells differentiated, more or less enlarged, subrectangular and in some cases moderately inflated and hyaline, in most incrassate and colored, often remaining attached to the stem when the leaves are removed. Capsule cernuous or horizontal, ovoid to subcylindric, unsymmetric or arcuate, usually contracted under the mouth when dry and empty; peristome perfect (*alpinum* has cilia rudimentary or lacking); annulus present; operculum mammillate to conic-apiculate.

This genus is nearest to *Drepanocladus*, from which it is distinguished by its habitat in running streams, and its relatively broader, concave and more obtuse leaves. *Scorpidium* is distinguished by its gigantic size and rugose leaves; *Calliergon* by its habitat and general appearance. *Sematophyllum marilandicum* bears a very close resemblance to this genus in habitat and in general appearance when sterile, but its alar cells are more inflated and hyaline and the costa is very short or wanting. Aquatic *Brachytheciae* have a similar habitat and appearance but are easily distinguished by the acutely acuminate leaves, strong single costa, and rough seta, except in the case of *Scleropodium* species, in which the leaves may be blunt with short apical cells. *S. obtusifolium* was at first put in this group as a subspecies of *Hypnum*. Slender forms of *S. apocladum* approach this genus closely, but when in fruit the rough seta is a certain distinction. *Eurhynchium rusciiforme* is often sought here also. In this species the seta is smooth but the operculum is long-rostrate.

Type species *H. palustre*.

Our species may be arranged in the following groups:

I. *Palustriformes*. Leaves more than twice as long as broad, very concave with upper margins often infolded, entire or slightly serrulate above, alar cells various; includes *palustre*, *alpestre*, *polare*, *eugyrium*, *subeugyrium* and *styriacum*.

II. *Arctici*. Leaves less than twice as long as broad (except *closteri*), often nearly circular in outline, more or less concave, entire or slightly serrulate at apex; margins usually plane. Includes *Smithii*, *cohlearifolium*, *molle*, *dilatatum*, *alpinum*, *Bestii*, *closteri* and *norvegicum*.

III. *Montani*. Stems without central strand. Leaves ovate, acuminate to apiculate, distinctly serrulate to serrate above, slightly decurrent, lower margins reflexed; *montanum* and *novae-caesareae*.

IV. *Ochracei*. Outer layer of stem cells enlarged and hyaline forming a hyaline sheath, *ochraceum*.

Key.

- | | |
|--|------------------------------|
| 1. Outer layer of stem cells enlarged, thin-walled and hyaline, forming a conspicuous hyaline sheath..... | 1. <i>ochraceum</i> . |
| Outer stem cells not as above..... | 2. |
| 2. Costa <i>usually</i> single, reaching the middle of the leaf or beyond..... | 3. |
| Costa lacking, or short and double or forking..... | 9. |
| 3. Leaves small, less than 1 mm. in length..... | 4. |
| Stem leaves more than 1 mm. in length..... | 6. |
| 4. Stem and leaves stiff and harsh to the touch; leaves widely spreading, nearly as broad as long..... | 8. <i>Smithii</i> . |
| Plants soft; leaves loosely suberect to falcate-secund, longer than broad..... | 5. |
| 5. Leaves strongly concave; upper leaves falcate-secund..... | 3. <i>pseudomontanum</i> . |
| Leaves slightly concave to nearly plane, neither falcate nor secund..... | 11. <i>closteri</i> . |
| 6. Costa strong, rarely forking, reaching nearly or quite to the leaf apex..... | 7. |
| Costa strong, single or forking, rarely reaching much beyond the middle of the leaf..... | 8. |
| 7. Leaves broadly oblong-ovate, erect-spreading, only occasionally slightly secund at ends of stem and branches..... | 4. <i>polare</i> . |
| Leaves narrowly oblong-ovate to oblong-lanceolate, mostly secund, usually falcate, varieties of..... | 2. <i>palustre</i> . |
| 8. Stem leaves broadly obtuse to apiculate, concave, but with upper margins scarcely inrolled..... | 5. <i>alpestre</i> . |
| Stem leaves gradually acuminate, acute to narrowly obtuse; upper margins usually strongly inrolled..... | 2. <i>palustre</i> . |
| 9. Leaves broadly ovate to suborbicular..... | 10. |
| Leaves lanceolate to broadly ovate-lanceolate..... | 14. |
| 10. Leaves exceedingly concave, entire, less than 1 mm. long..... | 9. <i>cochlearifolium</i> . |
| Leaves slightly concave to nearly plane, often serrulate at apex, more than 1 mm. long..... | 11. |
| 11. Plants stiff, harsh to the touch, leaves widely spreading, broadly ovate to suborbicular, often somewhat secund..... | 12. |
| Plants soft, broadly ovate, not secund..... | 13. |
| 12. Leaves very large, reaching 3 mm. in length..... | 14. <i>Bestii</i> . |
| Leaves rarely over 1.5 mm. in length..... | 13. <i>dilatatum</i> . |
| 13. Plants moderately robust; leaves reaching 1.5 mm. in length; widely distributed in the Northwest..... | 12. <i>molle</i> . |
| Plants slender; leaves ± 0.7 mm. long; known in North America from Greenland only..... | 10. <i>norvegicum</i> . |
| 14. Leaves distinctly serrulate in the upper half at least..... | 15. |
| Leaves entire or minutely denticulate at extreme apex..... | 16. |
| 15. Leaves serrulate nearly or quite to base, more or less falcate secund; quadrate alar cells not appreciably inflated..... | 15. <i>montanum</i> . |
| Leaves serrulate in the upper half only, sometimes slightly secund but not falcate; alar cells somewhat inflated..... | 16. <i>novae-caesareae</i> . |
| 16. Extreme angular leaf cells somewhat inflated, hyaline or colored..... | 6. <i>eugyrium</i> . |
| Extreme angular cells only slightly or not at all inflated..... | 17. |
| 17. Some leaf apices denticulate..... | 7. <i>subeugyrium</i> . |
| All leaf apices entire..... | 2. <i>palustre</i> . |

Hypnum malocladum Card. & Thér. Bot. Gaz. 37: 380. Pl. 25. 1904, is omitted because of lack of data on the label. North America is too vague and too likely to be erroneous.

1. HYGROHYPNUM OCHRACEUM (Turn.) Loeske, Moosfl. d. Harz. 321. 1903.

Hypnum ochraceum Turn. mscr., Wils. Bryol. Brit. 400. 1855.

Plants in wide loose submerged mats, green, yellowish-green, or brown, often tinged with red; main stems prostrate or floating, reaching 9 cm. in length, irregularly branching, branches comparatively few,

procumbent to ascending, usually curved at the ends; central strand of few cells; *outer layer of stem cells conspicuously enlarged and hyaline*; leaves close, *usually strongly falcate-secund*, concave, entire except at the *minutely denticulate apex*, about 1.8×0.9 mm., *oblong-ovate to oblong-lanceolate, slightly rounded at base, gradually tapering to the longer or shorter blunt apex*, often somewhat contorted above; *costa variable, single or double*, often reaching the middle of the leaf or beyond; median leaf cells linear-flexuose, $5-6 \mu$ wide, $8-15:1$; apical much shorter; basal shorter and broader; *alar abruptly enlarged, inflated and hyaline, forming large conspicuous decurrent auricles*. Dioicous; capsule brown, oblong-ovoid, unsymmetric, $2-2.5 \times 1$ mm., cernuous to horizontal, contracted under the mouth when dry; operculum conic-apiculate; annulus of 3-4 rows of cells; peristome perfect. Spores in summer, infrequently produced. Type locality English.

ILLUSTRATIONS.—Br. & Sch. Bry. Eur. *pl.* 580; Jennings, Mosses W. Pa. *pl.* 41; M. H. M. *pl.* 80.

EXSICCATI.—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 305, and 304 as *Hypnum molle*, (Ed. 2) 452; Aust. Musc. Appal. 437; Allen, Mosses Cascade Mts. 139; Grout, N. Am. Musc. Pl. 111, 111a, 220 & 278; R. & C. Musc. Am. Sept. Exsic. 140.

Frequent on stones and ledges in cool mountain brooks or northern streams. Northern U. S. and Canada across the continent, northwards to the arctic regions; south to N. Jersey, W. Virginia, Pennsylvania, Colorado and Utah.

Several varieties are described, mainly habitat forms. The enlarged hyaline outer stem cells furnish an easy and almost infallible means of identification.

Var. FLACCIDUM (Milde) Grout, including var. *complanatum* (Milde) Loeske [See Dix. & Jam. Handb. Brit. Mosses (Ed. 3) 544] is a large floating form, sometimes almost black, with leaves distant, not falcate, little or not at all secund, often somewhat complanate, reaching 2.5 mm. in length; costa long and forking. Often with the gross appearance of *Leptodictyum riparium*. Grout, N. Am. Musc. Pl. 240, 299 & 467.

Var. UNCINATUM (Milde) Loeske. Habit of *Drepanocladus*, ends of stems and branches hooked, all leaves strongly falcate-secund, often almost circinate, slender, long-acuminate.

Var. FILIFORME (Limpr.) Grout. Very slender, floating, with long slender branches, nearly julaceous; leaves appressed-imbricate not secund; leaves at ends of stems and branches imbricate into a straight erect tip.

N. Am. Musc. Pl. 386 seems to be near this variety. No. 380 is so different from all other forms examined that if it were not for the inflated outer stem cells one would never refer it to this species. The leaves are short-oblong to oblong-ovate, less than half the usual size, gradually and rapidly narrowed to the rounded obtuse serrate apex; costa strong, single. A similar form but with characters nearer those of the usual form is in the Canadian National Museum at Ottawa as "*Hypnum pseudomontanum* Kindb." from Port Etches, Alaska, June 18, 1892. Coll. Macoun. It is only a starved depauperate form. It is not at all like the type of *pseudomontanum* from Owen Sound.

2. HYGROHYPNUM PALUSTRE (Huds., Hedw.) Loeske, Moosfl. d. Harz. 319. 1903.

Hypnum palustre Huds. Fl. Angl. 429. 1762, & Hedw. Sp. Musc. 292. 1801.

Limnobium palustre Br. & Sch. Bry. Eur. fasc. 55-56. *pl.* 574. 1853.

Hypnum luridum Hedw. Descr. 4: 99. *pl.* 38: 1797.

Plants exceedingly variable, slender to robust, dark to yellowish-green, forming rather loose mats or patches; stems more or less prostrate, usually denuded of leaves at the base, irregularly branching; central strand of small cells; branches erect to ascending, sometimes curved or hooked at the ends; leaves close, variously arranged, sometimes imbricated all around the stems making them julaceous, more frequently secund, *entire, nearly always concave with the edges strongly incurved above, often making the upper leaf sub-tubulose*, narrowly to broadly oblong-ovate, 1-1.5 mm. long by about 0.6 mm. wide, exceedingly variable in the upper part, acuminate and obtuse or acute, or rounded-obtuse and apiculate; *costa variable in leaves from the same plant*, single and reaching the middle of the leaf or beyond, often forking, in other cases shorter and double or forking, sometimes faint; median leaf cells linear-rhomboidal, about 6μ wide, $6-10:1$, rarely longer; basal shorter and broader, *quadrate to short-rectangular; differentiated alar cells relatively few, about 14μ wide, usually rather opaque and granulose; below these a few somewhat inflated cells at the very base of the somewhat decurrent angles* (these are usually left on the stem when the leaves are removed); alar and basal cells often highly colored. Monoicous; seta 15-20 mm. long; capsule short-oblong or oblong-ovoid, reaching 2.5 mm. in length, unsymmetric, cernuous to horizontal, strongly contracted under the mouth when dry and empty, brown to red; operculum conic, blunt to apiculate; annulus lacking; peristome perfect. Spores in summer.

Type locality European.

ILLUSTRATIONS.—Br. & Sch. l. c.; Dixon & Jam. Handb. Brit. Mosses *pl.* 69*N*; *Pl.* 23.

EXSICCATI.—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 305; Aust. Musc. Appal. 435; Grout, N. Am. Musc. Pl. 362; Allen, Mosses Cascade Mts. 140.

On rocks in and near cold streams, Northern U. S. and Canada, south to New Jersey, Pennsylvania and Colorado. Rare in the East, apparently common in the Rocky Mts.

Var. *SUBSPHAERICARPUM* (Schleich.) Amann, Fl. Mouss. Suisses 357. 1912.

Hypnum subsphaericarpon Schleich. Cat. 1807.

Robust, leaves large, falcate-secund, tapering and nearly tubulose above with the infolded edges; costa thick, reaching $\frac{3}{4}$ length of leaf or even to the apex. Capsule ovoid, short and thick, the urn almost as broad as long.

Michigan, Holt; British Columbia, MacFadden; Connecticut, Nichols.

Var. *JULACEUM* (Br. & Sch.) Loeske, Moosfl. d. Harz 320. 1903.

Hypnum palustre var. *julaceum* Br. & Sch. Bry. Eur. fasc. 55-56, *pl.* 575. 1853.

Branches ascending, nearly simple, julaceous; leaves broadly oblong to ovate, loosely imbricate, short-acuminate, concave; costa single, reaching the middle of the leaf or beyond, in some of the leaves often shorter and double or forked. Sporophyte as in var. *subsphaericarpon*.

New Mexico, British Columbia, Alaska and probably throughout the Rocky Mountain range of the species.

Hypnum pseudoarcticum Kindb. Bull. Torr. Bot. Club 17: 280. 1890, from British Columbia, Macoun, sent to Dr. M. A. Howe by Kindberg himself is a form of *Hygrohypnum palustre* having the leaves rather abruptly short-acuminate and less infolded than usual, but characteristically infolded in some, not crenulate to any noticeable extent. Macoun's no. 373 from Sicamous, B. C., one of the type localities, is the same thing. Another specimen at the N. Y. Botanical Garden from Griffen Lake, B. C., another of the original localities, is, in the opinion of R. S. Williams and myself, a form of *H. dilatatum*. It is smaller than usual with very concave leaves, resembling *H. cochlearifolium* but easily distinguished by the more strongly decurrent and crenulate-serrate leaves. This is probably what Kindberg used as the type in describing his supposed species. The *H. pseudoarcticum* in the Canadian National Museum at Ottawa is a similar mixture with the addition of a form of *H. molle*.

Hypnum columbico-palustre C. M. & Kindb., Macoun, Cat. Can. Pl. 241. 1892, from "rocks at the mouth of the Illicillewaet Canyon, near Revelstoke, B. C., May 18, 1890. (Macoun)" is a not unusual wide-leaved form of *H. palustre*. The specimen studied is from the Canadian National Museum at Ottawa. It is from the type locality, collected at the same date as the type. The leaf form and leaf cells are much like Allen's Mosses of the Cascade Mts. no. 140, but the costa averages longer and stronger. The author considers this a form of the var. *julaceum* of *H. palustre*. *H. palustre* seems to be a species in an active state of evolution and it is difficult to draw specific lines. *H. alpestre*, *H. polare*, *H. styriacum* and possibly *H. eugyrium* are derivatives and are at times very difficult to distinguish from each other and from forms of *palustre*. On the other hand, in the even more variable *aduncus* and *fluitans* groups of *Drepanocladus*, the indications are that the variability is due largely to habitat conditions, especially variation in available moisture.

Hygrohypnum styriacum (Limpr.) Broth. is regarded by Limpricht himself as a subspecies of *palustre* and I have been unable to differentiate the American plants referred to *styriacum* from forms of *palustre*. It differs from the usual form of the narrow-leaved *palustre* in that the alar cells are less differentiated, there being scarcely any large cells at the extreme angles and the upper margins are not noticeably infolded, though the upper part of the leaf is quite concave.

Dixon (Handb. Brit. Mosses, 541) says of *H. palustre* "There are two distinct groups into which its varied forms may be separated, one with the leaves widely ovate, hardly tapering, obtuse or apiculate, imbricated all around the stems so as to render them julaceous, not or hardly at all secund (laxer and denser forms of this group are described under the names of var. *laxum* B. & S. and var. *julaceum* B. & S.); the other with the leaves more or less tapering above to an obtuse or, more rarely, acute point; to this group the two varieties described belong." (i. e. vars. *subsphaericarpon* B. & S. and var. *hamulosum* B. & S.)

Var. *EHLEI* (Arnell) n. comb.

Amblystegium Ehlei Arnell, Ark. For. Bot. 13: 74. 1913.

Densely caespitose, cushions 1-2 cm. deep, quite rigid, glossy, bright yellow, darker below; branches more or less crowded, erect, curved at the ends by the falcate-secund leaves; costa yellowish, strong, vanishing a little below the apex or percurrent; leaf cells narrow, flexuose, $40-50 \times 6 \mu$, having thick cell walls; alar cells a little broader, shorter, rectangular to quadrate, hyaline; branch leaves increasing in size from the base of the branch upwards, upper falcate-secund, about 1.3×0.65 mm., not decurrent, concave, narrowly ovate, gradually narrowed to an obtuse or acute apex, occasionally slightly dentate at apex; costa 0.04-0.065 mm. wide at base; leaf cells sometimes broader and shorter than described above.

Collected in the Lena valley, Siberia by N. Nilsson Ehle, and by S. Berggren in Greenland at Tessiursak in 1870 and distributed as *Hypnum polare*.

"Differs from the related *H. polare* in the second and falcate leaves gradually narrowed from the base."

The above description and remarks are adapted and quoted from the original by Arnell. *Ehlei* approaches the form of var. *subsphaericarpum* from Michigan collected by Holt and distributed as *H. polare* but considered by the author to be an extreme form of *H. palustre*. This same form was collected at Kamloops, B. C., by Mrs. MacFadden.

The leaf cells do not materially differ from the descriptions of those of *polare* by various authors.

A specimen of *Amblystegium Ehlei* from the Lena valley, collected by Ehle, probably a co-type, has been very kindly sent me by Dr. Arnell himself. Var. *Ehlei* is intermediate between *H. palustre subsphaericarpum* and *H. polare*. From the former it differs chiefly in its less differentiated alar cells, occasionally crenulate leaf apices, and less tubulose upper leaf. From *H. polare* it differs chiefly in its more second leaves, narrower and more narrowed toward the apex.

*3. HYGROHYPNUM PSEUDOMONTANUM (Kindb.) Grout, Check List 17. 1929.

Hypnum pseudomontanum Kindb., Macoun, Cat. Can. Pl. 6: 243. 1929.

Plants in rather thick loose mats, bright to dark green above, brown below; secondary stems and branches erect to ascending, 2-3 cm. long, little branched; lower leaves distant, minute and scale-like; *lower median leaves close, loosely erect-imbricate when dry*, brown, somewhat unsymmetric, $0.7-0.9 \times 0.6$ mm., very concave, often cucullate, round-ovate to oblong-ovate, at apex rounded-obtuse, bluntly short-acuminate or apiculate, often with apiculus incurved, entire, scarcely decurrent; *costa single, well developed and extending to the middle of the leaf*; leaf cells oblong-hexagonal, $30-35 \times 7 \mu$; apical much shorter; basal shorter and broader; at basal angles a well-defined group of somewhat enlarged clear subrectangular cells; bordering these a group of small quadrate cells; *upper leaves smaller, hooked at ends of stem and branches, strongly falcate and rather irregularly second as in H. montanum, narrower, more gradually acuminate, obtuse with upper margins incurved as in H. palustre*. Monoicous. Sporophytes not yet found. Pl. 24B.

Type from "Streams around Owen Sound, Ontario, especially below Jones Falls and the Potawatomie Falls, Sept. 15, 1890." Coll. Macoun. Typical specimens of the type collection from Potawatomie Falls have been studied. Brotherus considered this so near *H. palustre* that he did not transfer it to *Hygrohypnum* in the second edition of Engler & Prantl.

The upper portions of the plants do resemble *H. montanum* macroscopically, but if the lower leaves were all like the upper, one would refer it with little hesitation to a form of *H. palustre*. The lower leaves, however, are so different from the main run of *palustre* as to deserve at least subspecific rank when the very blunt apex of all the leaves is also taken into consideration. This species has also been collected on Anticosti Island by Brother Victorin.

4. HYGROHYPNUM POLARE (Lindb.) Broth. Engler & Prantl, Musci (Ed. 1) 1041. 1909.

Hypnum polare Lindb. Kgl. Vet-Ak. Förh. 23: 540. 1866.

In rather dense soft masses, light to dark green; *secondary stems and branches erect, subjulaceous; leaves broadly oblong to oblong-ovate, loosely imbricate, more or less appressed when dry, slightly or not at all second, very concave, rounded, subcucullate and often apiculate* but upper margins not infolded; *costa strong, extending nearly or quite to the apex, in some leaves projecting into an apiculus much as in Barbula unguiculata*. Dioicous. Sporophyte unknown.

ILLUSTRATIONS.—Broth. Laubm. Fennosk. 498. f. A-B; Pl. 17A, figs. 13 & 14. Greenland, Berggren; Yukon, Williams.

Several authors, including Husnot and Roth, seem to have confused this species with var. *subsphaericarpum* of *H. palustre* because of the very long strong costa of the latter. The upper leaf margins of *polare* are not infolded and it seems to be confined to the Far North. The plants collected by Holt and Cooper near Lake Michigan and referred to *H. polare* do indeed approach it in many respects, and the costa in some leaves projects into an apiculus, but I feel pretty sure they belong rather to *H. palustre subsphaericarpum*.

5. HYGROHYPNUM ALPESTRE (Sw., Hedw.) Loeske, according to Brotherus.

Hypnum alpestre Sw. Musc. Suec. 63. pl. 6, f. 16. 1799, and Hedw. Sp. Musc. 247. pl. 64, figs. 1-4. 1801.

Hypnum rivulare Sw. Vet.-Akad. Handl. Holm. 262. 1795.

Hypnum Krausei C. Muell. Flora 1887: 224.

Plants in rather thick soft loose mats, yellowish green above, reddish to brown below; stems 3-10 cm. long, stout, prostrate, not radiculose; *branches erect, julaceous, blunt; leaves crowded, closely imbricate when dry*, sometimes slightly turned to one side, reaching 1.8×0.7 mm., *oval-oblong to elliptic-oblong, very concave*,

somewhat decurrent, rounded obtuse or shortly apiculate and often slightly serrulate at apex; margins plane; costa strong, forking and reaching to or beyond the middle of the leaf, or single and reaching nearly to the apex; leaf cells thick-walled, the median linear-flexuose, 5-7 μ wide, 8-12 : 1; apical shorter; basal shorter and broader; at basal angles a small group of subquadrate cells, below these usually a few larger and somewhat inflated cells which are hyaline in young leaves, but colored and with thicker walls when old. Monoicous; capsule 2.2 mm. long, elongate-ovoid, \pm cernuous, chestnut, contracted under the mouth when dry and empty; annulus of 2-3 rows of cells. Spores in summer.

Type locality European.

ILLUSTRATIONS.—Hedw. l. c.; Bry. Eur. pl. 577; Husnot, Musc. Gall. pl. 119; Limpr. Laubm. 3: f. 428; Pl. 22D.

Rare. On stones in far northern streams of Europe and N. America. Skagway and Lake Lindeman, Alaska; near Banff, British Columbia; Yoho National Park, B. C.; Greenland.

Williams says of the Alaskan specimens "In older leaves the very distinctly inflated cluster of alar cells is apparently always more or less deep red, sometimes the whole base becoming colored." Distinguished from *H. eugyrium*, its nearest relative, by the more robust habit, much stronger and longer costa, and usually less inflated alar cells.

Type duplicates of *Hypnum Krausei* have been studied and no essential difference between it and *alpestre* could be seen.

The group of inflated alar cells may be somewhat larger than is shown in the illustration.

Distinguished from *Calliergon turgescens* by the smaller size, smaller leaves, narrower leaf cells and crenulate obtuse leaf apex, which lacks the recurved apiculus so often present in *turgescens*.

Leaves may be found in which the development of the costa is almost identical in the two species, but in most of the leaves the costa is longer and very much stronger in *alpestre*. *H. alpestre* at times resembles also broad-leaved forms of the polymorphous *H. palustre*.

6. HYGROHYPNUM EUGYRIUM (Br. & Sch.) Loeske, l. c.

Limnobia eugyrium Br. & Sch. Bry. Eur. fasc. 62-64, Suppl. 1, pl. 579. 1855.

Hypnum eugyrium Schimp. Syn. (Ed. 1) 639. 1860.

Plants in rather wide, dense, sand-filled mats or patches, bright green above, brown below, sometimes yellowish; stems prostrate; branches numerous, procumbent to erect; leaves erect-spreading when moist, loosely imbricate when dry, usually more or less secund at the ends of stems and branches, very concave with margins often infolded above, giving the plant a turgid julaceous appearance; leaves of the main branches and stems oblong-ovate to oblong-lanceolate, $\pm 1.4 \times 0.5$ mm., acute at apex, narrowed but not rounded at the more or less clasping base; leaves of smaller branches narrower, lanceolate; leaves often denticulate at apex; costa very short and double or lacking; median leaf cells linear-flexuose, about 6 μ wide, 6-10 : 1; apical cells shorter; basal not much different from the median except thicker-walled and usually colored (except in young leaves); alar cells suddenly enlarged and inflated, the inner usually thick-walled and colored, the marginal thin-walled and hyaline, or colored in old leaves, forming distinct auricles. Monoicous, capsules short, ovoid to oblong, 2-3 : 1; operculum convex-conic; annulus of two or three rows of cells, deciduous; peristome perfect. Spores in spring. Type locality, a waterfall in the Black Forest of Baden.

ILLUSTRATIONS.—Br. & Sch. l. c., M. H. M. 344.

EXSICCATI.—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 303; Aust. Musc. Appal. 438; Grout, N. Am. Musc. Pl. 61, 129 & 323.

On rocks in streams in elevated regions, Newfoundland to Alaska, south or N. Carolina and Colorado, not rare.

The leaves of this species vary greatly; they may be broadly ovate or ovate-lanceolate, merely concave or with the upper margins infolded until they almost touch. The inflated alar cells vary in number from 3-5 in the lowest row next the insertion and from 2-3 along the margin, and these cells vary from 25-60 μ in length and from 21-37 μ in width. The amount of coloring and cell wall thickening of these cells is progressive with age. The leaves are often described as decurrent but I find this rare and only in a slight degree; the clasping base seems to have been mistaken for a decurrent angle. The costa is double and usually short, but occasionally one branch will reach fully to the middle of the leaf.

Var. *Mackayi* (Schimp.) Broth. is described as more robust with leaves scarcely secund and alar cells less conspicuously inflated, but in our American plants these variations do not seem to be correlated and it seems best to ignore this varietal name for them.

Dixon says of the British plants "the var. *Mackayi* does not appear to be very clearly marked off from the type, the characters given being none too constant."

Sematophyllum marylandicum (C. Muell.) E. G. Britton, is easily mistaken for this species, but its

enlarged alar cells are fewer in number and much more strongly inflated; also the leaves are much less concave and the upper margins are not infolded. In fruit its capsules are smaller and the operculum rostrate.

Forms of *H. palustre* approach *eugyrium*, but its extreme alar cells are never so much inflated and the number of small quadrate angular cells is greater; farther, *palustre* has entire leaves, usually rounded to the insertion.

*7. HYGROHYPNUM SUBEUGYRIUM (R. & C.) Broth. Engler & Prantl, Musci (Ed. 1) 2: 1039. 1909.

Hypnum subeugyrium R. & C. Bot. Gaz. 22: 5. pl. 5. 1896.

Plants dark dirty-green with a few light-green tips; leaves less concave and margins less infolded above than in *eugyrium*, shortly acute with serrulate apex; basal cells shorter and broader; enlarged alar cells few and small, surrounded by small quadrate to subrectangular cells. Pl. 22A.

Type from "Exploits, Newfoundland," Waghorne. Plant described from Exploits River below Grand Falls, Newfoundland, Fernald and Wiegand no. 6499, July 10, 1911. Also noted from Sweden, comm. Carl Stenholm. Subspecies of *eugyrium*.

This might easily be referred to *H. palustre* except for its serrulate leaf apices.

Var. OCCIDENTALE (Card. & Thér.) Grout, Check List 16. 1929.

Hypnum subeugyrium occidentale Card. & Thér. Proc. Wash. Acad. Sci. 4: 342. 1902.

Plants light yellowish-green; leaves broader than in the typical form, especially above, softer, rounded to the apiculate entire apex which is often cucullate; alar cells more inflated in the subspecies but less inflated than in *eugyrium* itself, granulose but not colored; costa single and reaching beyond the middle of the leaf.

Type from Yakutat Bay, Alaska, Trelease no. 1784; also from Muir Glacier. Both collections seen. Also collected in British Columbia by Brinkman and Mrs. MacFadden (Kamloops, no. 697). The lack of color may be due to the youth of the specimens studied. Very close to *H. palustre julaceum* but the alar cells are rather larger. It seems probable that this form would be better classified as a form of this variety of *palustre*.

8. HYGROHYPNUM SMITHII (Sw.) Broth. Engler & Prantl (Ed. 1) 2: 1039. 1909.

Leskea Smithii Sw. Liljebl. Sv. Fl. (Ed. 3) 544. 1816.

Hypnum arcticum Sommerf. in Wahl. Flor. Lapp. 65. pl. 2. 1826.

Limnobia arcticum Br. & Sch. Bry. Eur. fasc. 55-56. pl. 578. 1853.

Plants in firm compact patches on stones in mountain brooks, brown to blackish, bright green at the young growing tips, very slender, branches ascending to erect, rigid, harsh to the touch when dry, more or less denuded of leaves below; leaves spreading, not secund, 0.5-1 mm. long, broadly round-ovate to suborbicular, nearly or quite as broad as long, rounded and very obtuse at apex, slightly decurrent, concave with plane entire margins; costa stout, single, reaching $\frac{1}{2}$ - $\frac{5}{8}$ the length of the leaf (rarely short and double); median cells linear-elliptic, flexuose, thick-walled, 7-9 μ wide, 4-6 : 1, shorter and rounder at apex and margins; basal shorter and broader; differentiated alar cells few, incrassate, subrectangular and colored, forming very small indistinct auricles. Monoicous; seta about 1 cm. long; capsule chestnut, elongated-ovoid, somewhat unsymmetric, cernuous or horizontal, reaching 1.5 mm. in length, operculum conic-apiculate; peristome perfect; annulus of two rows of cells. Spores in summer.

Type locality, Scandinavia.

ILLUSTRATIONS.—Br. & Sch. l. c.; Pl. 23.

EXSICCATI.—Drumm. Musc. Am. 194; Macoun, Can. Musc. 358 ?†

Very rare. British Columbia, California, Washington, Montana, Greenland, Cape Breton Island.

Hypnum torrentis C. M. & Kindb. Cat. Can. Pl. 6: 243. 1892, is merely an exceedingly slender form of this species with leaves less than 0.5 mm. long, fully as broad as long. It is probably the same as var. *Goulardi* Husnot. Musc. Gall. 414. See Can. Musc. 403. The type in Kindberg's herbarium is a habitat form of swift cold waters.

9. HYGROHYPNUM COCHLEARIFOLIUM (Vent.) Broth. l. c.

Limnobia cochlearifolium Vent. in DeNot. Nat. Erb. Critt. Ital. 2nd series, Fasc. 10. 1871.

Hypnum Goulardi Schimp. Syn. (Ed. 2) 778. 1876.

Very close to *H. Smithii* from which it differs in the shorter thinner double costa and exceedingly concave leaves, which are at times almost hemispheric. Very rare.

Washington, Piper, no. 123, det. Brotherus; Electric Peak, Yellowstone National Park, Rydberg.

† Grout, N. Am. Musc. Pl. 259 is not this species but is nearer *Scleropodium apocladum* (Mitt.) than any species known to the author. The leaves are ovate and mostly obtuse, entire and rounded at apex, occasionally broadly acute and somewhat serrulate at apex; leaf cells not flexuose. The stems and branches frequently end in slender, almost flagelliform extensions. It would help greatly if it could be found in fruit. For it I propose the name *Scleropodium apocladum* var. *OBTUSUM* n. var.

10. HYGROHYPNUM NORVEGICUM (Br. & Sch.) n. comb.

Limnobium norvegicum Br. & Sch. Bry. Eur. fasc. 55-56. pl. 576. 1853.*Hypnum viridulum* Hartm. Skand. Fl. (Ed. 5) 524. 1849 (not Bridel, Mant. Musc. 179. 1819).

Plants slender, in loose soft mats, dark to yellowish-green; stems creeping, 1-3 cm. long, with short erect branches; leaves loosely appressed when dry, widely erect-spreading when moist, somewhat decurrent, somewhat concave, entire, rounded-obtuse at apex; stem leaves $\pm 0.7 \times 0.5$ mm., broadly ovate; costa short and double; branch leaves smaller and often proportionally narrower; median leaf cells thin-walled, 0.6μ wide, 5-6 : 1; those at apex shorter; basal broader and shorter, oblong-rectangular; angular but a trifle different, about 9μ wide. Autoicous; seta about 1 cm. long; capsule short-oblong, cernuous ± 2 mm. long; operculum mammillate; annulus of two rows of cells; peristome perfect. Spores in August.

Type locality European.

ILLUSTRATIONS.—Bry. Eur. 1. c.; Pl. 24C.

The only North American record is from two Greenland localities reported by C. Jensen in the Flora of Greenland. In appearance it reminds one of a slender non-complanate form of *Plagiothecium elegans*. The leaves differ from those of *H. closteri* chiefly in the short double costa and proportionally broader outline. The habit is so different from the last as to make confusion of the two almost impossible.

11. HYGROHYPNUM CLOSTERI (Aust.) Grout, M. H. M. 346. July, 1910.

Hypnum closteri Aust. Musc. Appal. 439. 1870.*Amblystegium Holzingeri* R. & C. Bot. Gaz. 19: 240. pl. 210. 1894.

Plants very slender, in loose masses, often intermingled with *Hygroamblystegium* and other similar mosses; green to dirty yellow-green; stems creeping, irregularly branching, often somewhat denuded of leaves below; leaves distant, widely spreading, rarely if ever secund; stem leaves oblong-ovate to ovate, reaching 0.8×0.45 mm., usually narrower, slightly or not at all concave, broadly obtuse at apex, sometimes slightly unsymmetric, quite entire, scarcely decurrent; costa single, reaching $\frac{1}{2}$ length of leaf or longer, sometimes shorter and forked; normal branch leaves smaller and less strongly costate; branch leaves of the sometimes almost flagelliform branches broadly ovate, obtuse, flat and often almost ecostate; median leaf cells oblong-linear to fusiform with protoplasmic contents conspicuous, about 7μ wide, 3-5 : 1; apical and upper marginal shorter; basal shorter and broader; alar slightly enlarged; perichaetial leaves entire, costate, with narrow cells. Seta 6-8 mm. long, red-brown; capsule brown, ovoid, strongly unsymmetric, cernuous, strongly contracted under the mouth when dry and empty; annulus broad; peristome perfect; operculum depressed-conic and apiculate. Spores in spring.

Type, Austin's Musc. Appal. 439 from New York or New Jersey.

ILLUSTRATIONS.—R. & C. 1. c.; Pl. 24A.

EXSICCATI.—Aust. 1. c.

On stones in cool brooks, northeastern U. S., south to Virginia. Widely distributed but very rare or overlooked. Should be sought for in collections of *Hygroamblystegium*. Reported from Vermont, New York, New Jersey, District of Columbia, Virginia, and eastern Pennsylvania.

It resembles *H. palustre laxum* but is distinguished easily by the more obtuse leaves.

Forma SERRULATUM n. f.

Leaf cells broader, clearer; many leaves distinctly serrulate above. Bolivar Run, McKean Co., Pennsylvania. Burnett, no. 3208, Sept. 11, 1898. Type in herb. A. J. G.

12. HYGROHYPNUM MOLLE (Dicks., Schimp.) Loeske. 1. c. 320.

Hypnum molle Dicks. Crypt. Fasc. 2: 11, pl. 5. f. 8. 1790, and Schimp. Syn. (Ed. 2) 775. 1876.*Limnobium molle* Br. & Sch. Bry. Eur. fasc. 55-56, pl. 577. 1853.*Limnobium submolle* Kindb. Rev. Bryol. 22: 87. 1895.

Plants in rather loose soft patches, flaccid, olive green to brownish; stems 5-10 cm. long, procumbent, irregularly and rather sparingly branched; branches procumbent to ascending, long, tumid, and obtuse; leaves of stem and main branches about 1.5×0.75 mm., spreading to erect-spreading, not secund or falcate, broadly ovate, concave, soft, rather rapidly narrowed above the middle to a very broad rounded and obtuse apex, strongly narrowed and rounded to the insertion at base, entire or finely serrulate above; costa bi-trifid, usually short, occasionally one stronger branch reaching the middle of the leaf or beyond; median cells about 7μ wide, 5-8 : 1 (10-15 : 1, Dixon), broadly linear-flexuose; apical shorter; cells broader and shorter towards the base and becoming colored and short-rectangular to quadrate at the decurrent basal angles; perichaetial

leaves denticulate above. Monoicous; capsule ovoid, cernuous and unsymmetric, with a short and narrow neck, $\pm 2 \times 0.65$ mm., contracted under the mouth when dry and empty; operculum conic-apiculate; annulus of 3-4 rows of cells; peristome perfect. Spores in summer.

Type locality European.

ILLUSTRATIONS.—Dixon & Jam. Handb. Brit. Mosses, *pl. 59W*; *Pl. 22C*.

EXSICCATI.—Drumm. Musc. Am. 194; Grout, N. Am. Musc. Pl. 382; Allen, Mosses Cascade Mts. 142 (as *Hypnum arcticum*).

On stones in streams; arctic-alpine and infrequent. Northwestern U. S. and western Canada from the Rocky Mts. northward and westward.

The comparatively large size and broad rounded leaves make this and the next fairly easy to recognize, but the distinctions between the two do not always hold, as there are intermediate forms. Grout, N. Am. Musc. Pl. 442 is the same as 446. (See *H. dilatatum*), both the rigid habit and the widely spreading leaves indicate *H. dilatatum*, but some of the leaves on plants of 442 are almost as long as in *molle*, others are typical of *dilatatum*. Mrs. MacFadden has sent me from Revelstoke, British Columbia, a form growing on a submerged log, having the leaves somewhat secund but otherwise appressed-imbricate. Dr. C. M. Roberts has sent me a similar form from a similar habitat on San Juan Island, Washington. Under the microscope they are typical *molle*, but the appressed leaves give the plant a very slender and unusual appearance.

Another unusual form from the San Bernardino Mts., California, alt. 1000-1500 ft., on rocks in very rapid water about six inches deep, S. B. Parish no. 3884, Feb. 20, 1908, in the herbarium of the New York Botanical Garden, has small leaves, 1-1.2 mm. long, somewhat secund, concave; leaf cells $\pm 60 \times 10 \mu$, with very conspicuous protoplasmic contents.

These plants were labeled "*Hypnum pseudoarcticum* Kindb." but they do not seem to correspond with any available material of that very doubtful species and they seem nearer *H. molle* than anything else known to me.

*13. HYGROHYPNUM DILATATUM (Wils. Mscr.) Loeske, l. c.

Hypnum dilatatum Schimp. Syn. (Ed. 2) 776. 1876.

Limnobodium molle Br. & Sch. Bry. Eur. *pl. 576 & 577*.

Hypnum circulifolium C. M. & K., Macoun, Cat. Can. Pl. 6: 242. 1892.

Subspecies of *H. molle*. Plants stiff and harsh to the touch when dry, bright green at the young growing tips, brownish to almost black below; leaves often somewhat secund, widely spreading, even when dry, from a narrow subclasping subdecurent base, ovate-suborbicular, little longer than broad, rounded and obtuse at apex, or sometimes apiculate, finely serrulate in many cases; "cells longer in the lower part of the leaf" (Dixon), frequently orange brown at base.

Type locality English.

ILLUSTRATIONS.—Br. & Sch. l. c.; Dixon & Jam. Handb. Brit. Mosses *pl. 60A*; M. H. M. 345.

EXSICCATI.—Aust. Musc. Appal. 436, as *Hypnum molle*; Grout, N. Am. Musc. Pl. 260, 446, & 442 as *H. molle*.

On stones in cool mountain brooks in northern U. S. and Canada across the continent, south to W. Virginia, Arizona and New Mexico. Mr. Williams and I both agree that the Alaskan plants which he referred to *Hypnum alpinum* (Schimp.) Loeske (Bull. N. Y. Bot. Garden 2: 142, May 1901) are better referred to *H. dilatatum*.

*14. HYGROHYPNUM BESTII (Ren. & Bryhn) Broth. Engler & Prantl, Musci (Ed. 1) 2: 1040. 1909.

Limnobium Bestii Ren. & Bryhn, Rev. Bryol. 28: 8. 1901.

Plants in deep loose cushions, pale olive-green, rigid and rather harsh to the touch when dry; stems stout, firm, 6-8 cm. long, generally defoliate below, divided into several erect branches; central strand lacking; leaves distant, spreading, often squarrose above, broadly ovate, concave, very large, reaching 3×2 mm., narrowed from above the middle and obtusely acute at the apex, which is often slightly denticulate; costa very strong, bifid, the longer branch often extending to the middle of the leaf or beyond; median leaf cells linear-fusiform, about 10μ wide, 6-10:1, the upper shorter; basal shorter and broader; differentiated alar cells few, slightly enlarged, rectangular, forming indistinct auricles. Fruit unknown.

Type from Avalanche Basin, Montana, alt. 1500 m. Co-type seen.

ILLUSTRATIONS.—Bryologist 4: *pl. e.* 1901; *Pl. 26C*.

EXSICCATI.—Grout, N. Am. Musc. Pl. 251; Allen, Mosses Cascade Mts. 141, as *Hypnum dilatatum*.

In alpine and glacial rivulets, Montana, Washington, British Columbia; "Alaska to California," Brotherus, l. c.

This is a subspecies of *H. molle*. It has the habit and appearance of *dilatatum* and the leaf form of *H. molle*. The leaf cells are larger than in either; N. Am. Musc. Pl. 251 is softer, with leaves less spreading than in the type. It is very close to *molle* but was determined by Dr. Best.

15. *HYGROHYPNUM MONTANUM* (Wils.) Broth. Engler & Prantl, Musci (Ed. 1) 1039. 1909.

Hypnum montanum Wils. Mscr., James, Proc. Acad. Nat. Sci. Phila. 1885: 47.

Plants almost as small as *H. arcticum*, in wide soft mats, light to dark green above, reddish brown below; stems slender, prostrate, without central strand, mostly defoliate; secondary stems and branches numerous, suberect, 1–2 cm. long; leaves falcate-secund to squarrose, slightly decurrent, ovate to ovate-lanceolate, acuminate, acute at apex, about 0.75×0.3 – 0.35 mm., sharply serrate above, serrulate nearly or quite to the base; margins reflexed below; costa short and double; median leaf cells about 5μ wide, 6–10 : 1; basal and apical cells shorter; at basal angles a few short-oblong to quadrate cells scarcely forming auricles; leaf-like paraphyllia occasional. Monoicous; seta 1–2 cm. long, curved just below the capsule; capsules oblong-cylindric, unsymmetric and cernuous, about 2.5 mm. long, contracted under the mouth when dry and empty; operculum conic-apiculate; annulus large; peristome perfect. Spores in late spring to early summer.

Type from the White Mts. in New Hampshire.

ILLUSTRATIONS.—Sull. Icon. Musc. pl. 113; Pl. 22B.

EXSICCATI.—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 306; Aust. Musc. Appal. Suppl. 546; Grout, N. Am. Musc. Pl. 397 & 485.

On moist rocks in mountain brooks and along their banks; mountains of New England; Ontario, Newfoundland, also in northern Europe and Japan.

A small but very pretty and distinct species. When growing on boulders in brooks it seems to be on the surface of the stone between low and high water, while *H. ochraceum* grows lower down, submerged all the time.

16. *HYGROHYPNUM NOVAE-CAESAREAE* (Aust.) n. comb.

Hypnum Novae-Caesareae Aust. Musc. Appal. 440. 1870.

Hypnum micans Wils. in Hook. Brit. Fl. 2: 86. 1833 (not Swartz, 1829).

Chrysobryum micans Lindb. in Sull. Icon. Musc. Suppl. 91. pl. 67. 1874.

Sematophyllum micans Braithw. Brit. Moss Fl. 3: 154. pl. 113B. 1902.

Plants in thin tangled mats on stones in cold mountain streams, light green in most American plants, often glossy golden green in Great Britain; main stems without central strand, prostrate, 2–5 cm. long; branches few, slender, the branchlets often incurved; both stems and branches long, slender and stoloniferous at the ends and bearing small distant leaves; normal leaves rather close, erect-open, imbricated when moist, subclasping and narrowly decurrent at base, sometimes slightly secund, broadly ovate to suborbicular, apiculate to shortly acuminate, concave with margins somewhat reflexed below, plane and serrulate above, 0.6–0.8 mm. long; costa short and double or forking, often faint or wanting; median leaf cells linear-flexuose, 6–7 μ wide, 6–10 : 1; apical much shorter; basal somewhat shorter and broader; alar quadrate to rectangular, somewhat enlarged, usually with a characteristic row of clear, hyaline or colored cells at the basal margin. Dioicous, found in fruit but once, in western Pennsylvania; capsules small, obovate, nearly symmetric, cernuous to horizontal; operculum shortly rostrate; annulus of one or two rows of cells; exothelial cell walls not collenchymatous; cilia of peristome lacking.

Type locality British.

ILLUSTRATIONS.—Sull. l. c.; Braithw. l. c.; Jennings, Mosses Western Pa. pl. 48; M. H. M. 364. f. 193.

EXSICCATI.—Aust. l. c.; Grout, N. Am. Musc. Pl. 306.

In mountainous regions, Vermont to Georgia, west to western Pennsylvania. Rare and local in most places, frequent in the mountains west of Asheville, N. Carolina.

Apparently most American plants are the large form with better-developed costa and larger alar cells described by Herzog (Rev. Bryol. 28: 76. 1901), as var. *badense*.

8. *SCORPIDIUM* (Schimp.) Limpr. Laubm. 3: 570. 1899.

Hypnum subgenus *Scorpidium* Schimp. Syn. (Ed. 1) 650. 1860.

We have one species only. Its relationships have been a standing puzzle to systematists. Assigned to *Amblystegium* by Lindberg, to *Calliergon* by Sullivan, to *Harpidium* by Milde and to *Limnobium* by Dixon. Moenkemeyer has referred *Calliergon turgescens* to this genus, but this seems to the author not justified by the facts, although the superficial resemblance is often great.

SCORPIDIUM SCORPIOIDES (L., Hedw.) Br. & Sch. Bry. Eur. pl. 612. 1854.

Hypnum scorpioides L. Sp. Pl. 1127. 1753, & Hedw. Sp. Musc. 296. 1801.

Hypnum subturgescens Kindb. Ottawa Nat. 23: 137. 1909.

Plants very robust, one of the largest of mosses, reaching 3 dm. in length; divisions little branched or with short branches; forming large soft masses of a dark or brownish green, often reddish, sometimes nearly black; branches and branchlets curved at ends, very turgid by reason of the very concave imbricated leaves; leaves more or less falcate-secund; stem leaves $2-4 \times 1.4-2$ mm., not much plicate but rugose when dry, broadly ovate-oblong, narrowed to the insertion, not decurrent, abruptly narrowed to an obtuse or apiculate apex, entire (occasionally acute or acuminate and slightly denticulate at apex); costa faint, short and double, or even lacking; median leaf cells narrowly linear-flexuose, 15:1, thick-walled, a few cells at the insertion shorter and wider, a few at extreme angles somewhat inflated and thinner-walled. Dioicous: seta very long, 4-6 cm.; capsule strongly curved from an erect neck, plicate and contracted under the mouth when dry; peristome perfect; annulus very large. Spores in late summer. Distinguished from *Calliergon* by its aquatic habitat, great size and dark color. *Drepanocladus Wilsoni* approaches it in size, but in *D. Wilsoni* the leaves are costate and slenderly acuminate.

ILLUSTRATIONS.—Bry. Eur. l. c.; Dixon & Jam. Handb. Brit. Mosses, pl. 60E; Pl. 27C.

EXSICCATI.—Drumm. Musc. Am. 200; Sull. Musc. Allegh. 27; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 310, (Ed. 2) 459; Aust. Musc. Appal. 446; Grout, N. Am. Musc. Pl. 449 & 449a.

There are slender forms with leafy stems not more than $\frac{1}{2}$ the diameter of the normal form.

Plants of bogs and wet places, often submerged and floating; widely distributed but apparently infrequent and local. Northern U. S. and Canada across the continent, south to New Jersey, Ohio, Michigan, and Montana.

9. CALLIERGON (Sull.) Kindb. Eur. & N. Am. Bryin. 1: 79. 1896. (in part).

Hypnum subgenus *Calliergon* Sull. Mosses of the U. S. 72. 1856.

Plants of swamps and wet places, more or less robust, growing in loose masses, sometimes intertangled with other mosses, green, yellowish-green, or reddish purple. Stems with central strand, mostly elongated when submerged or in deep swamps, erect or ascending with few radicles; in dry situations more prostrate and sparingly radiculose; sparingly branched (except *C. giganteum*). Stem leaves spreading to erect-imbricate, usually concave, seldom much plicate, ovate to suborbicular, mostly with rounded and more or less cucullate apices (a few species apiculate or short-acuminate), with plane entire margins. Costa strong, often percurrent or nearly so. Median leaf cells linear to elongated linear-hexagonal; basal and alar shorter and broader, alar thin-walled, hyaline and more or less inflated when young (except in *Pseudocalliergon*); branch leaves smaller and narrower. Seta long reddish, smooth; capsules oblong-ovoid to subcylindric, more or less arcuate and cernuous, usually somewhat contracted under the mouth when dry; operculum conic to conic-apiculate; annulus lacking to broad.

Type species *C. cordifolium* (Hedw.) Kindb.

KEY.

- | | |
|---|--------------------------|
| 1. Alar cells thick-walled and more or less colored, ordinarily little different from the other basal cells; costa thin, often faint (<i>Pseudocalliergon</i>)..... | 2. |
| Alar cells thin-walled, hyaline and more or less inflated; costa strong and conspicuous, often nearly percurrent (<i>Eucalliergon</i>)..... | 3. |
| 2. Plants turgid with the large concave, often apiculate leaves; angular cells smaller than other basal cells, quadrate..... | 9. <i>turgescens</i> . |
| Plants more slender, not turgid; leaves rounded and blunt at apex; basal and angular cells sometimes slightly inflated..... | 8. <i>trifarium</i> . |
| 3. Costa not extending farther than $\frac{3}{4}$ the length of the leaf..... | 4. |
| Costa reaching nearly or quite to leaf apex..... | 5. |
| 4. Slender, yellowish-green to straw-color; stem leaves usually suberect and imbricated when dry, oblong to ovate-oblong..... | 7. <i>stramineum</i> . |
| More robust, brighter green; stem leaves spreading to erect-spreading, broadly cordate-ovate to suborbicular..... | 2. <i>Richardsoni</i> .* |
| 5. Stem leaves much longer than broad, oblong to oblong-ovate..... | 6. |
| Stem leaves nearly as broad as long, widely cordate-ovate..... | 9. |
| 6. Plants purplish or red when old..... | 7. |
| Green or brownish below, rarely with any tinge of red..... | 8. |

* *Orbiculari-cordatum* may be sought here.

7. Leaves oblong-lanceolate, acuminate and acute. 6. *pseudosarmentosum*.
 Stem leaves oblong, rounded and obtuse, often cucullate and apiculate at apex 5. *sarmentosum*.
 8. Branches few and irregular; autoicous. 1. *cordifolium*.
 Branches usually numerous and more or less pinnately arranged; dioicous. 4. *giganteum*.
 9. Median leaf cells linear, about 8:1. 4. *giganteum cyclophyllotum*.
 Median leaf cells oblong-hexagonal to oblong-linear, 4-5:1. 3. *orbiculari-cordatum*.

1. CALLIERGON CORDIFOLIUM (Hedw.) Kindb. Eur. & N. Am. Bryin. 1: 80. 1896.

Hypnum cordifolium Hedw. Musc. Frond. 4: 97. pl. 37. 1797 & Sp. Musc. 254. 1801.

Usually robust and tall, reaching 20 cm., bright or yellowish green above, brown below, more or less erect, stems usually divided but with few short branches; stem leaves more or less spreading, closely imbricate into a bud at the stem ends, soft, somewhat shrinking when dry, with plane entire margins, 2-5 mm. long cordate-ovate to ovate-oblong, somewhat concave, rounded at apex and usually cucullate, at base rounded and narrowed to the long-decurrent insertion; branch leaves smaller, oblong-lanceolate; costa single, reaching within a few cells of apex; median leaf cells 90-150 × 8-12 μ, linear, pointed, thin-walled; marginal narrower, apical shorter and broader; cells toward the base gradually becoming shorter and wider across the whole base; alar cells larger, not sharply delimited, thin-walled and hyaline, more or less inflated. Autoicous; seta 5-8 cm. long; capsules large, oblong-arcuate, cernous to horizontal, reaching 4.5 mm. in length, light brown to chestnut; operculum conic to conic-apiculate; annulus lacking; peristome perfect hypnaceous. Spores in late spring.

Type locality European.

Common in swampy places and pools and even in shallow sluggish streams across the northern part of the continent, south to New Jersey, Pennsylvania and Ohio.

ILLUSTRATIONS.—Bry. Eur. pl. 615; M. H. M. pl. 76; Jennings, Mosses W. Pa. pl. 40.

EXSICCATI.—Drumm. Musc. Am. 209; Sull. & Lesq. Musc. Bor. Am. (Ed. 1), 309 (Ed. 2) 457; Austin, Musc. Appal. 441, 442; Sull. Musc. Allegh. 34; Grout, N. Am. Musc. Pl. 40, 209a.

This species varies a great deal in robustness. One of the slender forms has been described as var. *angustifolium* (See Limpricht, Laubmoose 3: 549). There is also a great variation in the alar cells; in western plants, especially those from west of the Rockies, the alar cells tend to become as much inflated and as sharply delimited as in the next. Provisionally this western form is called

Forma INTERMEDIUM n. forma, Type, Grout, N. Am. Musc. Pl. 209, which Thériot identified wrongly as *C. richardsoni*. Allen's Mosses of the Cascade Mts. no. 127 is also this form. This form has the percurrent costa of *cordifolium* while that of the next stops far short of the apex.

*2. CALLIERGON RICHARDSONI (Mitt.) Kindb. Eur. & N. Am. Bryin. 1: 80. 1896.

Stereodon richardsoni Mitt. Journ. Linn. Soc. 8: 42. 1865.

Hypnum richardsoni L. & J. Manual 404. 1884.

Hypnum breidleri Jur. Hedwigia, 14: 182. 1875.

Hypnum subgiganteum Kindb. Ottawa Nat. 14: 80. 1900. (Type seen.)

Subspecies of *C. cordifolium*, from which it differs in the less spreading leaves which are less distantly placed, giving the stems, especially in European plants, a stouter appearance; the costa extends from $\frac{2}{3}$ - $\frac{3}{4}$ the length of the leaf only; the inflated hyaline alar cells are sharply delimited, forming conspicuous decurrent auricles.

Type locality American. "Supposed by Drummond to be from the Great Bear Lake." A specimen, evidently the type, in Herb. Mitten at the N. Y. Botanical Garden has been seen.

Northern U. S. and Canada, Vermont, Isle Royal in Lake Superior and also in "boggy ground north of Lake Superior," Newfoundland, Prince Edward Island, Greenland. Dixon considers the specific value of *C. richardsoni* as "very doubtful" and it will doubtless be found to intergrade with both *C. cordifolium* and *C. giganteum*. Pl. 17A, figs. 10-12.

*3. CALLIERGON ORBICULARI-CORDATUM (R. & C.) Broth. Engler & Prantl, Musci, (Ed. 1) 1037. 1909.

Hypnum orbiculari-cordatum R. & C. Bull. Herb. Boissier 4: 19. 1896.

"Tufts very soft, pale lurid green above, decolored, whitish-yellow and brownish-variegated below."

"Stems slender, erect, 4-9 cm. high, simple or sparingly branching, not radiculose, cuspidate at apex."

"Leaves soft, erecto-patent or very loosely imbricate, subundulate when dry, decurrent at base, broadly

cordate-suborbicular, very obtuse, quite entire, slightly sulcate; *costa thin*" sometimes vanishing far from the apex, usually as in *cordatum*; "areolation loose, pellucid, cells soft, thin-walled, rhomboidal-hexagonal in the middle, the marginal narrower, the upper shorter, the alar very loose, large, soft and empty." "Flowers and fruit unknown." Type from "Northwest shore of Hudson's Bay: Depot Island, N. Lat. 63°, 79'; W. Long. 90°, 20' (George Comer, 1893, comm. D. C. Eaton). Type in Herb. Cardot, at the Nat. Hist. Museum, Paris.

Type duplicate R. & C. Musc. Am. Sept. Exsic. 249. Seen at N. Y. Bot. Garden.

ILLUSTRATIONS.—Bot. Gaz. 22: 5. pl. 4B. 1896; Pl. 19B.

A good species, related *C. cordifolium*, from which it is "Easily distinguished . . . by the stems nearly simple, the leaves very soft, broader, and the looser areolation." (Quotations from the Bot. Gaz. description.)

Grout, N. Am. Musc. Pl. 370 is apparently a type duplicate, though the latitude is given on the label as N. Lat. 63°, 31' instead of 63°, 79' given as the type locality. Otherwise the labels match exactly. The costa is usually as nearly percurrent as in *cordifolium* and is so shown in one of Cardot's figures. The median leaf cells as shown in his figures are characteristic and unmistakable.

4. CALLIERGON GIGANTEUM (Schimp.) Kindb. l. c.

Hypnum giganteum Schimp. Syn. (Ed. 1): 642. 1860.

Hypnum cordifolium var. *stenodictyon* Br. & Sch. Bry. Eur. Mon. Hypnum 47. 1854. (no plate).

Stereodon giganteus Mitt. l. c. 43. 1865.

Plants aquatic to subaquatic, often nearly submerged, in deep loose masses, dark green, brown or reddish below, usually very robust, 7–30 cm. long; stems ascending to erect, bearing few or no radicles; branching almost regularly pinnate with numerous close branches of a somewhat irregular length; ends of stem and branches usually somewhat cuspidate; stem leaves large, 3–4 × 1.4–2 mm., more or less plicate when dry, widely cordate-ovate, spreading to erect-spreading, in the larger forms somewhat appressed-imbricate and crowded, in slender forms with fewer and shorter branches, the leaves are as distant and spreading as in *C. cordifolium*, somewhat decurrent, obtuse and cucullate at apex with the apical margins sometimes inrolled until they nearly meet, margins otherwise plane and entire; *costa broad and strong*, usually tapering but little until it vanishes in the apex; median leaf cells long linear-flexuose, 100–140 × 7 μ, narrower toward the margins, apical cells twice as wide, 3–4:1; alar cells forming auricles, large, abruptly inflated, thin-walled and hyaline, 30–40 μ wide, mostly oblong-hexagonal, in some cases reaching almost to costa but usually separated from it by several smaller thick-walled cells; branch leaves smaller and narrower, oblong to oblong-lanceolate. Dioicous; sporophyte much as in *C. cordifolium* but rarely produced. Spores in late spring.

Type locality European.

ILLUSTRATIONS.—Limpricht, Laubmoose 3: 553, f. 432; Dixon & Jam. Handb. Brit. Mosses pl. 60 J; Pl. 19A.

EXSICCATI.—Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 458, 468; Aust. Musc. Appal. 443; Grout, N. Am. Musc. Pl. 253, 253a, 354 & 484; Allen, Mosses of the Cascade Mts. 138; Dutton, Vt. Musci 334.

In cool swamps, northern U. S. and Canada across the continent, south to Pennsylvania and New Jersey. Not rare but rather infrequent and local. The darker color, closely pinnate branching and more crowded leaves distinguish this species markedly from *C. cordifolium* in well developed forms. In slender forms seemingly partial to cedar swamps, as in the exsiccati of Austin and Dutton, the plants are more slender than in most *cordifolium*, the leaves are as distant and the branches comparatively few and short; the sharply delimited inflated auricular cells will usually serve to enable identification of such forms. There are, however, numerous puzzling intermediate forms, and forma *intermedium* of *cordifolium* has alar cells almost as inflated and sharply delimited as in *giganteum*.

Mitten's remark that the American forms of this species are more slender than the European is true in general, but we have forms, particularly in the West, that are as robust as the European.

Var. *CYCLOPHYLLOTUM* (Holzinger) Grout, n. comb.

Hypnum cyclophyllotum Holzinger, Minn. Bot. Stud. Bull. 9: 691. pl. 39. Nov. 1896.

C. giganteum var. *brevisfolium* Limpr. Laubm. 3: 555. 1899. (According to R. S. Williams.)

Small, 8–10 cm., little branched; stem leaves very broad and short, in some cases fully as broad as long, but usually at least 1–1.5:1; median leaf cells shorter and broader, especially in the lower 1/3 of the leaf. Described from "Part of the type" communicated by Holzinger. Other plants with similar stem leaves have been observed from different localities but they differ so much in branching or slenderness that it has not seemed best to refer them to this variety. Pl. 19C.

Var. *FLUITANS* (Klinggr.) Roth, Europ. Laubm. 2: 574. 1904.

Hypnum giganteum fluitans Klinggr. Leberm. and Laubm. 292. 1893.

A large floating form; leaves reaching 4.5×3 mm., distant; branches few, irregular. Near March Lake, Yukon Terr. and Columbia Falls, Montana, Williams.

Resembling *Fontinalis gigantea* Sull. and growing in similar situations. The leaves may graduate down to those 1 mm. in length.

Var. *DENDROIDES* (Limpr.) Grout, Check List, 17. 1929.

Hypnum giganteum var. *dendroides* Limpr. Laubm. 3: 555. Nov. 1899.

Plants with lower branches often long and all the branches with more or less numerous branchlets; stem leaves $3.6 \times$ about 2 mm. Columbia Falls, Montana. Williams.

Var. *labradorensis* (R. & C.) Grout. Check List, 17. 1929. *Hypnum labradorensis* R. & C. Bot. Gaz. 19: 240. 1894.

"Distinct from the type by the leaves larger and longer and the costa attenuate, vanishing rather far from the apex and often forking. Battle Harbor, Labrador, Waghorne." Poorly characterized and should be ignored.

5. *CALLIERGON SARMENTOSUM* (Wahlenb.) Kindb. l. c.

Hypnum sarmentosum Wahlenb. Fl. Lapp. 380. 1812.

Calliergon subsarmentosum Kindb. Ottawa Nat. 23: 137. 1909.

Plants in deep thick tufts or mats, *characteristically dark purplish-crimson*, green at the growing tips; stems 8–15 cm. long, more or less denuded of leaves below, not radiculose, *irregularly and sparingly branched*; stem leaves rather close, irregularly spreading to loosely imbricate, *elliptic-lanceolate to narrowly oblong*, narrowed and decurrent at base, reaching 2.5×1 mm., often smaller, *concave and cucullate at apex*, obtuse or shortly apiculate; margins entire and plane except at the inrolled apex; costa extending almost to apex; median leaf cells narrowly linear-flexuose, about 6μ wide and 10–15 times as long, rather thin-walled, growing shorter, broader and thicker-walled towards the base; cells at the insertion oblong-rectangular, incrassate and colored; *the outer thin-walled, inflated and often hyaline, forming well-defined decurrent auricles*; branch leaves smaller, oblong-lanceolate, often acute to acuminate. Dioicous; capsules rarely produced, smaller and narrower than in the preceding species; annulus lacking; operculum long-apiculate. Spores in early summer.

Type locality European.

ILLUSTRATIONS.—Bry. Eur. pl. 616; Pl. 20.

EXSICCATI.—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 311b as *Hypnum stramineum* var., (Ed. 2) 461; Grout, N. Am. Musc. Pl. 400a.

Cold bogs, northern New England and eastern Canada, Newfoundland, Greenland. Rare and local. Musc. Bor. Am. 311b has the shorter costa of *C. stramineum* but it has the color and the apiculate upper leaves of *sarmentosum*.

Specimens from Vancouver Id. collected by Macoun on July 13, 1906, labeled *Calliergon subsarmentosum* Kindb. fit the original description. The inflated alar cells are very large and extend to the costa. The costa is very stout, over 0.1 mm. in width and none of the leaves seem to be apiculate. It is merely a slight variation.

Hypnum hyperboreum Bryhn, Rept. 2nd. Norw. Arctic Exped. in the Fram, No. 11: 134. 1906.

Through the kindness of Dr. Johannes Lid of the Botanical Museum of the University of Oslo, I received a portion of the type of this species.

It is undoubtedly a form of *C. sarmentosum*, a delicate and depauperate arctic form slightly colored and differing in no essential detail of leaf structure.

Var. *BERINGIANUM* (Card. & Thér.) n. comb.

Differs from the typical form in the slender, more loosely foliate stems; costa broader, nearly 0.1 mm. wide, with inflated alar cells much smaller and much less numerous. Type collection, Trelease no. 1889, St. Matthew Id., has been studied through the courtesy of the Missouri Botanical Garden.

Var. *FONTINALOIDES* (Berggren) Grout, Check List. 1929.

Hypnum sarmentosum var. *fontinaloides* Berggren in Hartm. Skand. Fl. (Ed. 10) 4. 1871.

Stems long and slender, floating, with longer leaves, green or green and purple mixed; cell walls less thickened. More arctic-alpine than the species.

On rocks in bottom of a small stream near mouth of Bonanza Creek, Yukon Territory. Williams.

Concerning these forms Limpricht says (Laubm, 3: 561) "similar forms are developed by *C. giganteum* and other bog mosses when they float in quiet water.

Var. FALLACIOSUM (Milde) Broth. Laubm. Fennosk. 489. 1923.

Hypnum sarmentosum var. *fallaciosum* Milde, Bryol. Siles. 369. 1869.

Appearance of *C. stramineum*, stems reaching 10 cm. long, slender, in deep compact tufts. Grout, N. Am. Musc. Pl. 400b from Bonne Esperance, Labrador, seems to fit this though the color is darker than described by Limpricht.

6. CALLIERGON PSEUDOSARMENTOSUM (Card. & Thér.) Broth. Engler & Prantl, Musci (Ed. 2) 2: 348. 1925.

Hypnum pseudo-sarmentosum Card. & Thér. Univ. of Calif. Pub., Botany 2: 305. pl. 27. f. 2. 1906.

Plants in dark purplish masses; stems erect, 5-6 cm. long (original description says 8-10); irregularly to subpinnately branching; branches numerous, cuspidate, unequal; stem leaves erect-spreading from a sub-clasping base, not cucullate, $\pm 2 \times 0.8$ mm.; branch leaves smaller, imbricate when dry; all leaves broadly lanceolate to oblong-lanceolate, acuminate, acute at apex; margins slightly inflexed above, entire; costa stout, 60-70 μ thick at base, vanishing just below the apex; median cells narrowly linear, about 6 μ wide, 9-15:1; alar cells suddenly enlarged and inflated below a row or two of small short-oblong cells; costa and basal cells colored; outer alar cells nearly or quite hyaline; inner perichaetial leaves abruptly acuminate with an excurrent costa. Capsules (including operculum) about 2.5 mm. long, subcylindric, curved and unsymmetric; operculum long-conic, subrostrate. Spores in late summer.

Type seen; from Cape Nome, Alaska, Setchell and others. Type in herb. Univ. of California.

ILLUSTRATIONS.—Thér. l. c.; Pl. 25A.

This species has the gross appearance of *C. sarmentosum* but it is beautifully distinct and easily recognized by the acuminate and acute, non-cucullate leaf apices. It has not been reported since the original collection.

7. CALLIERGON STRAMINEUM (Dicks., Brid.) Kindb. l. c. 81.

Hypnum stramineum Dicks. Fasc. Pl. Crypt. 2: 6. pl. 1, f. 9. 1790.

Hypnum stereodon stramineum Brid. Musc. Rec. 2^o: 172. 1801.

Plants very slender, in deep soft masses, yellow green to straw color, darker below; stems 10-20 cm. long, erect or ascending, simple or sparingly branched, not radiculose or denuded of leaves below, often cuspidate by the convolute appressed leaves in American plants; stem leaves rather crowded, erect-open to erect-spreading when moist, when dry loosely appressed-imbricate and somewhat plicate, 1.5-2 \times .07-.09 mm., oblong to linguulate, entire, concave, obtuse, rounded, and somewhat cucullate at apex, decurrent, producing tufts of radicles on the back of the apex more often than the other species of the genus; median cells linear, about 6 μ wide, 8-15:1; lower cells shorter and broader toward the base, at angles suddenly enlarged, inflated, hyaline, forming well-defined decurrent auricles; apical widely rhomboidal to roundish-quadrate; costa reaching $\frac{3}{4}$ - $\frac{5}{6}$ the length of the leaf. Dioicous; seta 4-8 cm. long, reddish; capsule oblong-cylindric, curved and cernuous, 3-4 mm. long; operculum convex-conic; annulus lacking. Spores in late spring, rarely produced. Type locality European.

ILLUSTRATIONS.—Br. & Sch. Bry. Eur. pl. 617; Pl. 20.

EXSICCATI.—Drumm. Musc. Am. 210; Sull. Musc. Allegh. 38; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 311, (Ed. 2) 460; Aust. Musc. Appal. Suppl. 547; Grout, N. Am. Musc. Pl. 283, 370; R. & C. Musc. Am. Sept. Exsic. 345.

Infrequent and local; in cool bogs, especially at high altitudes; often mixed with *Sphagnum* and other bog mosses. New England; Adirondacks; Michigan; Wyoming, and in Canada across the continent.

8. CALLIERGON TRIFARIUM (Web. & Mohr.) Kindb. l. c. 85. 1896.

Hypnum trifarium Web. & Mohr. Iter Suec. 177, pl. 2, f. a-d. 1804.

Hypnum illecebrum Schultz, Fl. Starg. 308. 1806 (non syn.)

Hypnum stramineum var. *foliis latioribus*. Schwaegr. Suppl. 1^o: 212. pl. 89. 1816.

Plants resembling *C. stramineum* but stouter, with julaceous, slightly turgid stems, bright green above, brown below; stem leaves 1.5-2 \times 1.2-1.7 mm., appressed-imbricate both moist and dry, often finely striate when dry, widely ovate to suborbicular, widest at about the middle, spoon-shaped and very obtuse, entire,

scarcely decurrent; costa extending beyond the middle, often very thin in American plants; median leaf cells thick-walled, linear-flexuose, about $6\ \mu$ wide, 8-12:1, shorter but not broader at the apex; all basal cells shorter and broader, especially a row or two of short-oblong cells at the insertion which are little different at the basal angles as a rule. Dioicous; sporophyte not yet found in N. America, differing but little from that of *C. stramineum* except in the well developed annulus of 3-5 rows of cells. Spores in early summer.

Type locality, Switzerland.

ILLUSTRATIONS.—Bry. Eur. pl. 618; Pl. 21.

EXSICCATI.—Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 462, (Ed. 1) 312; Sull. Musc. Allegh. 39; Grout, N. Am. Musc. Pl. 350.

Deep cold bogs. Connecticut, Ohio, Ontario, Labrador, Greenland and northwards in Canada across the continent; very rare, often associated with *Scorpidium* and *C. turgescens*. Dr. G. E. Nichols writes that he has collected this species along the Straits of Mackinac in Michigan where it is abundant in shallow open calcareous bogs where the water becomes quite warm at times and also in northern Maine where it grows in great abundance submerged on the bottom of lakes 6-8 feet below the surface. In these places and in Connecticut he states that it is locally abundant.

9. CALLIERGON TURGESCENS (Schimp.) Kindb. l. c. 84.

Hynum turgescens (Schimp.) Syn. (Ed. 1) 648. 1860.

Plants in dense soft masses, golden yellow to olive-green, brownish to reddish below, sometimes incrustated with lime, very robust, tumid; leafy stems 4 mm. thick, sparingly branched; stem leaves reaching 3.3×1.2 mm. close, loosely to rather closely imbricate, not decurrent, but subclasping, ovate-oblong, very concave, cucullate and obtuse at apex or often with a minute recurved apiculus, entire; upper leaf cells wide and short for the genus, reaching $8\ \mu$ wide, 5-8:1, oblong-linear; the lower longer; those at base oblong to rectangular, incrassate, porose and often colored; at the basal angles are a few smaller, rounder-quadrate cells; costa short and thin, reaching about $\frac{1}{3}$ the length of the leaf, or short and double or forked. Dioicous; sporophyte known from 2 localities in Sweden only. Reproducing asexually by the falling off of the terminal buds of slender stolons.

ILLUSTRATIONS.—Dixon & Jam. Handb. Brit. Mosses, pl. 60H (In this figure the costa is stronger and longer than seems typical.); Pl. 26B.

EXSICCATI.—Macoun, Canadian Musci 483.

The rarest of the genus, apparently calcicolous; found in cold bogs often associated with other bog mosses. Davis Straits, Taylor; Rocky Mts., British Columbia, Macoun (several localities); Owen Sound Ontario, Moxley; Greenland.

Likely to be confused with *Hygrohypnum alpestre*. For distinctions see that species. Stunted forms with leaves less than 1.5 mm. long are found in Greenland.

10. CALLIERGIDIUM (Ren.) Grout, Ck. List 17. 1929.

Calliergidium (subgenus) Ren. Bryologist 5: 64. 1902.

Pseudocalliergon Ren. Bryologist 4: 64. 1901. (Not Limpr. Laubm. 3: 547. 1899.)

Plants inhabiting swampy regions, forming loose tufts, some of the species having the general aspect of certain species of *Drepanocladus*, another reminding one of *Calliergon*. Leaves rather distant, imbricate, occasionally somewhat secund, especially at the tips of stems and branches, obtusely acuminate; costa single, reaching the middle of the leaf or beyond, rarely short and forking in some leaves; median leaf cells linear, apical and basal shorter and usually broader, alar inflated and hyaline. The acuminate leaves distinguish this from *Calliergon* (except *C. pseudosarmentosum*) and the obtuse apex from *Drepanocladus* (except a few varieties).

The mosses of this type seem to be forms of deep bogs, and certain varieties of *Drepanocladus* have been referred to this genus. Indeed species referred here by Renauld are blunt-leaved *Drepanocladus*. *Hynum tundrae* Arnell is considered by Warnstorf and Brotherus to be a mere form of *Drepanocladus exannulatus* and *H. pseudostamineum* to be a form of *D. fluitans*. The fact that there is considerable difference in the acuteness of different leaves from the same plant is an argument in favor of putting all these forms under *Drepanocladus* as is done by Brotherus in the second edition of Engler & Prantl. The obtuse leaves of var. *obtusifolium* of the normally very acute-leaved *Leptodictyum riparium* furnish another argument for this view.

However, the general appearance and form of leaves is so different from that of *Drepanocladus* that it will be far more convenient to treat some of these forms under a separate genus, following the lead of that greatest of students of *Drepanocladus* (*Harpidium*), Mons. F. Renauld.

Type species, *C. Bakeri*.

KEY.

1. Leaves broadly ovate to ovate-elliptical, as a rule rather abruptly short-acuminate..... 2. *Bakeri*.
 Leaves lanceolate to triangular ovate, gradually narrowed to the narrowly obtuse apex..... 2.
2. Leaves with inflated angular cells forming decurrent auricles..... 1. *pseudostramineum*.
 Leaves with slightly inflated alar cells, not decurrent..... 1. var. *Hoveyi*.

1. CALLIERGIDIUM PSEUDOSTRAMEUM (C. Muell.) Grout, l. c.

Hypnum (subgenus *Calliergidium*) *pseudostramineum* Ren. l. c.

Hypnum pseudostramineum C. Muell., Bot. Zeit. 1855: 500.

Plants in soft loose delicate masses, green above, brown below; stems 5-10 cm. long, mostly erect, sparingly and irregularly branching; leaves rather distant, *stem leaves broadly lanceolate, narrowed and slightly decurrent at base, erect-spreading, not secund*, gradually acuminate, *narrowly obtuse, entire*; median stem leaves about 2×0.7 mm.; costa extending beyond the middle of leaf; median leaf cells about 7 μ wide, 8-12:1; apical much shorter; basal gradually shorter and broader; a considerable group of alar cells enlarged and moderately inflated, subhyaline; perichaetial leaves subsheathing, broadly ovate, gradually narrowed into a long acute subreflexed acumen, entire; costa faint. Seta reaching 5 cm.

Type locality Haale am Saale, C. Mueller.

ILLUSTRATIONS.—Proc. Wash. Acad. Sci. 4: pl. 23; Bryologist 4: pl. 7, figs 1a-d; Pl. 21, figs. 1a-b. Plants described from an "original" specimen from type locality collected by Mueller and sent to the author by Renaud.

Brotherus, Warnstorf and Monkemeyer regard this and allied forms as a variety or form of *Drepanocladus fluitans*, but if this view be correct, the erect nonsecund entire leaves with blunt apex will make it difficult for any one except an expert to identify these forms. Plants closely matching the type have been collected by Waghorne at Fox Cove, Labrador. Most American forms seem to belong to the variety *plesi-stramineum* (Ren.)

Var. PLESISTRAMEUM (Ren.) n. comb.

Hypnum plesi-stramineum Ren. l. c.

Calliergidium plesi-stramineum (Ren.) Grout, l. c.

Leaves closer together, more closely imbricated, broader, often triangular-ovate; costa thicker, leaf cells more flexuose.

Type from Yukon River, Dahl. The cotype in U. S. National Museum has been studied.

ILLUSTRATIONS.—In same plates as typical form; Pl. 21, figs. 2a-f.

EXSICCATI.—Grout, N. Am. Musc. Pl. 282, as *Amblystegium vacillans*, from Mt. Mansfield, Vt.

A form from Kotzebue Sound, northwest coast of Alaska, is more robust, darker green; stems reaching 8 cm.; stem leaves reaching 1 mm. wide; enlarged alar cells more numerous and more abruptly inflated. The alar cells of this form, found in the Mitten Herbarium at the New York Botanical Garden, remind one of those of *Brachythecium rivulare* and if the leaves were serrate and acute they would be indistinguishable from forms of that species. This appears to be identical with var. *japonicum* Ren. mscr. from Hakkoda Japan, coll. Rev. Faurie, comm. Ren.

Var. HOVEYI n. Var.

Leaves appressed imbricate; stem leaves oblong-lanceolate and gradually acuminate to *ovate-lanceolate and rather abruptly acuminate*, narrowly obtuse, *scarcely decurrent, somewhat narrowed to the insertion*, entire, $1.6-1.8 \times 0.36$ mm.; median leaf cells narrowly oblong-linear, acute at ends, varying greatly in length, usually about 8 μ wide by 35-50 μ long, occasionally reaching 90 μ in length; apical shorter; basal gradually somewhat shorter and broader; *alar subquadrate*. Differs from *C. pseudostramineum* in differently shaped leaves without decurrent inflated auricles and with wider leaf cells. Pl. 17A, 15 & 16.

Type locality, Greenland, Hovey. Type in herb. New York Botanical Garden as *Hypnum pseudostramineum*.

2. CALLIERGIDIUM BAKERI (Ren.) Grout, l. c.

Hypnum (*Calliergidium*) *Bakeri* Ren. Bryologist, l. c.

Tufts very lax and apparently floating, pale green, reddish or brown below; stems slender, without radicles, 8-10 cm. long, sparingly branched; leaves distant, spreading in all directions, the upper rolled

up into an oblong bud, *median broadly ovate, abruptly narrowed to a short obtuse acumination, more rarely subapiculate, subcucullate by the inflexed apex*, rarely more slenderly acuminate, all more or less rounded and contracted to the indistinctly decurrent base, occasionally plicate, entire, 1.5–2 mm. long; costa extending from $\frac{1}{2}$ – $\frac{3}{4}$ the length of the leaf, sometimes forked; median cells *elongated hexagonal to broadly linear*, 6–8 \times 25–30 μ , narrower toward the margin; apical cells shorter, subrhombic; basal broader and shorter; subquadrate alar cells numerous, somewhat enlarged, not forming auricles. Sporophyte unknown.

Type locality, Deer Lake, Polk Co., Wisconsin, in a sphagnum swamp, C. F. Baker, Nov. 1897. This was sent out in Baker's exchanges as *Hypnum arcticum* before Renauld described it as a new species.

Described from R. & C. Musc. Am. Sept. Exsic. 397 at New York Botanical Gardens. This number is evidently of the type collection.

ILLUSTRATIONS.—Bryologist, l. c., pl. 8; Pl. 21, figs. 3a–f.

This species has a slight resemblance to slender *Calliergon cordifolium*. It differs in the form of the leaves, the shorter costa and the much smaller leaf cells as well as the scarcely inflated alar cells.

11. CALLIERGONELLA Loeske, Hedwigia 50: 248. 1911 (emend.)

Plants in rather loose mats or tufts, green to reddish-brown, glossy, branching, *more or less regularly pinnate*, but scarcely in one plane; *central strand present but leaves ecostate or with costa short and double*. Stem leaves loosely appressed to erect-open, *scarioso, broad, obtuse and rounded at apex*, often cucullate with upper margins inrolled; median leaf cells linear-flexuose; alar differentiated, enlarged, in some cases inflated and hyaline. This genus differs from *Calliergon* chiefly in the nearly ecostate leaves. *Acrocladium* Mitt. Journ. Linn. Soc. 12: 531. 1869, is used for the subtropical species to which it was originally applied in part.

I have included in this genus *Hypnum Schreberi* Willd., which has been so variously placed by recent authors. Its leaf structure is much nearer this group than *Hylocomium* and its perfectly characteristic hypnoid capsules, curved and cernuous with a perfect peristome, make it ridiculous to place it in the Entodontae as is done in the second edition of Engler & Prantl. Not only the Bry. Eur. but also that most competent bryologist Mr. H. N. Dixon recognizes the affinity between *Hypnum Schreberi* and the *Calliergon* group. Type species, *C. cuspidatum*.

KEY.

1. Alar cells abruptly inflated, thin-walled and usually hyaline, forming decurrent auricles. *cuspidata*.
- Alar cells somewhat enlarged but not thin-walled nor forming auricles. *Schreberi*.

I. CALLIERGONELLA CUSPIDATA (L., Brid.) Loeske, l. c.

Hypnum cuspidatum L. Sp. Pl. 1127. 1753.

Hypnum stereodon cuspidatus Brid. Bryol. Univ. 2: 562. 1827.

Acrocladium cuspidatum Lindb. Musc. Scand. 59. 1879.

Calliergon cuspidatum Kindb. Eur. & N. Am. Bryin. 81. 1896.

Plants in deep loose masses, yellowish-green to brown below, often glossy; stems 8–15 cm. in length, erect to ascending, with irregularly pinnate branching; stems and branches *cuspidate at the tips by the convolute-appressed terminal leaves*; outer layer of stem cells large, thin-walled and hyaline; stem leaves loosely imbricate to erect-open, somewhat narrowed and decurrent at base, crowded, 1.5–2 mm. by a little less than half as wide, occasionally 2–5 \times 1.2 mm., widely elliptic-oblong to ovate-oblong, entire, at apex broad, rounded and obtuse, rarely with a short apiculus, concave and cucullate with the upper margins inflexed, ecostate or with costa short and double; branch leaves smaller and proportionally narrower; median leaf cells narrowly linear-flexuose, about 6 μ wide and 10–15 : 1; marginal narrower, apical shorter; basal shorter, broader and incrassate; alar suddenly enlarged, inflated and thin-walled, forming conspicuous decurrent auricles. Dioicous; seta 4–7 cm. long; capsule 3.5–4.5 \times 1–1.6 mm., subcylindric, arcuate and cernuous, somewhat wrinkled when dry; operculum conic-apiculate; annulus of 3–4 rows of cells; peristome perfect. Spores in late spring or early summer. Type European.

ILLUSTRATIONS.—Bry. Eur. pl. 619; Limpricht, Laubm. 3: 568. f. 434; Jennings, Mosses of W. Pa. pl. 40; M. H. M. 321, f. 167.

EXSICCATI.—Sull. Musc. Allegh. 32; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 307, (Ed. 2) 454; Aust. Musc. Appal. 444; Grout, N. Am. Musc. Pl. 90, 100 & 353; Allen, Mosses Cascade Mts. 128; Macoun, Can. Musc. 385.

In cool bogs and among grasses and other mosses in wet places, northern U. S. and Canada across the continent, south to northern New Jersey, Pennsylvania and Iowa.

2. CALLIERGONELLA SCHREBERI (Willd., Br. & Sch.) Grout, n. comb.

Hypnum Schreberi Willd. Prodr. Fl. Berol. 325. 1787, and Br. & Sch. Bry. Eur. fasc. 57-61, pl. 620. 1854.

Hypnum parietinum L. Flor. Suec. (Ed. 2) no. 1200. 1755.

Pleurozium Schreberi Mitt. Journ. Linn. Soc. 12: 537. 1869.

Plants bright to pale yellow-green, shining, in large loose mats or tufts; stems 10-15 cm. long, red, stiff and erect from a somewhat prostrate base, typically with rather closely pinnate but somewhat irregular branching, sometimes slender and little-branched, or again robust with the branches clustered at the top of the stem; branches terete, julaceous and often tapering; outer stem cells not enlarged; stem leaves reaching 2.4×1.5 mm., often smaller, rather loosely imbricate, lightly plicate when dry, entire or crenulate serrate at the obtuse rounded apex, widely oblong-ovate or elliptic, concave, with the margins strongly infolded near the apex and more or less reflexed near the base; costa faint and double or lacking; median leaf cells linear-flexuose, 7μ wide, 8-15 : 1; apical shorter, marginal narrower; basal shorter and broader, incrassate and porose, often colored; angular cells forming a triangular patch of enlarged, somewhat inflated subrectangular cells that are usually colored and subopaque; branch leaves similar but smaller and proportionally narrower. Dioicous; seta reddish; capsule about 2.5 mm. long, chestnut, subcylindric, arcuate and cernuous; annulus lacking. Spores in autumn.

Type European.

ILLUSTRATIONS.—Br. & Sch. l. c.; Jennings, Mosses of Western Pa. pl. 44; M. H. M. figs. 165 & 166.

EXSICCATI.—Drumm. Musc. Am. 208; Sull. Musc. Allegh. 33; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 308 & 308b, (Ed. 2) 455 & 456; Aust. Musc. Appal. 445; Grout, N. Am. Musc. Pl. 45, 45a & 479, Musci Perfecti 35; Allen, Mosses Cascade Mts. 129.

Common in moist shaded places, sometimes in swamps, again in places relatively dry for a portion of the year; northern U. S. and Canada across the continent, south to Virginia in the mountains.

Var. TANANAE Grout.

Calliergon tananae Grout, Pub. Puget Sd. Biol. Sta. 3^{ss}: 58. 1921.

Stems very slender and sparingly branched; stem leaves closely appressed-imbricate, shorter and proportionally broader, rounded and broadly obtuse at apex with the apical margins slightly or not at all infolded.

Type from Tanana, Alaska, O. D. Clark. Type in herb. A. J. Grout.

Another collection by the same collector at the same date and in the same general locality is very similar except that the plants have the typical pinnate branching. This variety seems to be an exceptionally slender arctic form.

12. DREPANOCLADUS (C. Muell.) Roth, Hedwigia 38: Beibl. 6. 1899.

C. Muell. Syn. 2: 321. 1851 as a subgenus. *Harpidium* Sulliv. Mosses of the U. S. 73. 1856, as a subgenus.

Plants slender to very robust, without paraphyllia (there are a few inconspicuous pseudoparaphyllia in *D. uncinatus*). Leaves usually falcate-secund to circinate, often forming conspicuous hooks at the ends of the stem and branches, not papillose, nearly always longly and slenderly acuminate; costa single and well developed, usually reaching well into the upper $\frac{1}{3}$ of the leaf; leaf cells very long and narrowly linear (shorter in forms of *aduncus*); alar cells in most species enlarged and inflated, forming more or less conspicuous decurrent auricles; basal cells usually shorter and thicker-walled, often porose. Capsules inclined to horizontal, subcylindric and curved, usually somewhat contracted under the mouth when dry, with a perfect hypnaceous peristome.

Type species *D. aduncus* (Hedw.) Moenkem. (Not *Hypnum aduncum* L.)

Of all the mosses this genus is probably the most difficult because of the extreme variability of the plants. Even the recognized authorities in the group identify many specimens by telling what they are nearest rather than by referring them definitely to a described form. Nearly all grow in water or very wet places and the amount of water and other conditions of their immediate environment appear to modify their growth profoundly. Sometimes two well marked varieties can be found on the same plant. So variable are the leaves that it is absolutely necessary to take fully developed leaves from the older portions of the stem for purposes of study and comparison. In removing these, great care must be taken to get all of the leaf as the characteristic swollen alar cells often remain attached to the stems.

Although the species are so difficult to define and identify, the genus itself is one of the easiest to recognize. *Scorpidium scorpioides* looks exactly like a large species of this genus but its short and double costa at once differentiates it. *Cratoneuron* species are often mistaken for species of this genus, but their abundant paraphyllia are very easy to observe and at once distinguish them from *Drepanocladus*.

D. aduncus, *D. fluitans* and their subspecies have forms with straight erect, often obtuse leaves that are very puzzling.

Drepanocladus, meaning sickle-branch, must replace the more familiar and less cumbersome *Harpidium* because *Harpidium* had previously been used for another genus of plants.

The studies of the late Captain Renault and the later work of Moenkemeyer have been freely consulted and drawn upon and my work has been greatly aided by numerous specimens identified by them and sent me for comparison when the treatment of this genus was in preparation for "Mosses with Hand-lens and Microscope."

Loeske (Hedwigia 46: 309. 1907) has divided this genus into several genera which are better regarded as sections or subgenera, and to these Brotherus has added *Pseudodrepanocladus* for the *Hypnum badii* of Hartman.

I. *Sanionia*. Autoicous. Stems with central strand; pseudoparaphyllia present at the origin of branches; leaves mostly circinnate, deeply plicate with many folds, distantly and finely denticulate; leaf cells very narrow, at the basal angles a few hyaline and thin-walled cells form a distinct small group but not decurrent auricles; inner perichaetial leaves plicate, sharply serrate above; annulus present.

Includes *D. uncinatus*.

II. *Limprichtia*. No pseudoparaphyllia; central strand small or lacking; leaves secund, falcate (except forms of *D. revolvens*); leaf cells very narrow; inner perichaetial leaves plicate, entire; annulus present. *D. vernicosus*; *D. revolvens*, *D. intermedius*.

III. *Warnstorfia*. Stems with central strand; no pseudoparaphyllia; leaves not plicate, more or less serrulate; alar cells inflated and hyaline, usually forming sharply defined decurrent auricles; inner perichaetial leaves not plicate; annulus lacking.

D. fluitans, *D. Berggrenii*, *D. exannulatus*.

IV. *Pseudodrepanocladus*. Dioicous. Stem with central strand; no pseudoparaphyllia; leaves not plicate, secund and more or less falcate, not decurrent, entire; all leaf cells unusually thick-walled; alar cells a rather distinct group of subquadrate incrassate porose cells that often remain attached when the leaves are removed; inner perichaetial leaves plicate, entire; annulus present; peristome teeth without the usual transverse striae. *D. badius* only.

V. *Drepanocladus* proper. Dioicous. Central strand present; leaves entire; alar cells usually inflated and distinct; inner perichaetial leaves plicate, entire; annulus present. *D. aduncus*, *D. Sendtneri*, *D. lycopodioides*, *D. brevifolius*.

KEY.

- | | |
|---|---------------------------|
| 1. Leaves plicate, often strongly so | 2. |
| Leaves not plicate, or only slightly so in <i>revolvens</i> and <i>lycopodioides</i> ; central strand present in all species* (lacking in <i>D. revolvens miquelonensis</i>) . . . | 3. |
| 2. Leaves without enlarged or inflated alar cells; stems without central strand and with small thick-walled cuticular cells | 2. <i>vernicosus</i> . |
| Leaves with a few larger but scarcely inflated alar cells; central strand present; outer layer of stem cells larger and thinner-walled than those underneath . . | 1. <i>uncinatus</i> . |
| 3. Leaves with only two to three inflated alar cells, often none | 4. |
| Leaves with enlarged and often inflated angular cells usually forming conspicuous auricles | 7. |
| 4. Stems with a layer of larger outer cells | 5. |
| Outer layer of stem cells not enlarged | 6. |
| 5. Robust, reddish; leaves with a very long slender acumination | 3. <i>revolvens</i> . |
| More slender, yellowish to green, brown below; acumination much shorter . . | 4. <i>intermedius</i> . |
| 6. Plants very large, 10-30 cm. long; leaves 3-6 mm. long | 6. <i>lycopodioides</i> . |
| Plants not over 4 cm. long; leaves ± 1.5 mm. long | 11. |
| 7. Leaves entire; annulus present | 8. |
| Some or all of the leaves serrulate, especially at the apex; annulus lacking . . | 10. |
| 8. Alar cells exceedingly thick-walled and porose | 5. <i>badius</i> . |
| Alar cells thin-walled or moderately thickened, rarely, if ever, porose | 9. |

**D. lycopodioides* and *D. Sendtneri* *Wilsoni* f. *giganteus* have leaves that are more or less rugose and often slightly plicate. Leaves of some *fluitans* or *exannulatus* forms are very slightly plicate.

9. Costa stout; enlarged auricular cells not reaching the costa, their cell walls usually somewhat thickened and colored when old..... 9. *Sendtneri*.
 Costa more slender; enlarged and inflated auricular cells often reaching the costa, not thickened and rarely much colored..... 8. *aduncus*.
 10. Costa stout, usually reaching well into the acumination; decurrent auricles large, made up of large inflated and usually elongated cells, usually reaching the costa..... 11. *exannulatus*.
 Costa more slender and usually shorter; inflated alar cells much less sharply differentiated, not reaching the costa and often not forming distinct auricles..... 10. *fruitans*.
 11. Lower leaf cells strongly porose**..... 7. *brevifolius*.
 Lower leaf cells not porose..... 12. *Berggrenii*.

1. DREPANOCLADUS UNCINATUS (Hedw.) Warnst. Beih. Bot. Centralbl. 13: 417. 1903.

Hypnum uncinatum Hedw. Musc. Frond. 4: 65, pl. 25. 1797, and Sp. Musc. 289. 1801.

Hypnum Moseri Kindb. Ottawa Nat. 4: 65. 1890.

Plants in wide thin intertangled mats, pale to golden green, sometimes brown below but *without any tinge of red or purple*; stems procumbent and often intertangled with other mosses, sometimes crowded and suberect, 2-10 cm. long, rather distantly and irregularly branched as a rule, but often more or less regularly pinnate; central strand present, outer layer of stem cells larger and thin-walled; stems and branches hooked at the end by the falcate-secund leaves; *pseudoparaphyllia present in the axils of the branches*; leaves rather close, strongly falcate-secund to circinnate, strongly plicate with numerous plicae whether wet or dry, narrowly elongated-lanceolate, 3.5-5 × 0.75-1 mm., slightly rounded and narrowed to the insertion, usually somewhat decurrent, gradually tapering to a very long and slender acumination which is usually strongly denticulate with rather distant teeth, rarely nearly entire; costa extending well into the acumination; median leaf cells linear-flexuose, 5 μ wide, 12-20 : 1; basal somewhat shorter and thicker-walled; cells at basal angles varying greatly, usually a few somewhat enlarged, hyaline and decurrent but not forming noticeable auricles; above these larger cells a few smaller quadrate cells; *perichaetial leaves very long and sheathing*, the inner 5-8 mm. long with an exceedingly long capillary acumination, plicate, costate, serrate above. Monoicous; seta 2-3 cm. long; capsule cylindric, arcuate, 2.5-3.5 × 0.75 mm., slightly contracted under the mouth when dry and empty; operculum conic with a large sharp apiculus, almost rostrate; annulus of three rows of cells; peristome perfect. Spores in spring (to early summer in the far north).

Type locality European.

ILLUSTRATIONS.—Bry. Eur. pl. 600; M. H. M. pl. 72.

EXSICCATI.—Drumm. Musc. Am. 202; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 313, (Ed. 2) 463; Sull. Musc. Allegh. 24; Aust. Musc. Appal. 412; Grout, N. Am. Musc. Pl. 106, 107, and 366; Allen, Mosses Cascade Mts. 132; R. & C. Musc. Am. Sept. Exsic. 134.

On earth, trees and stones in moist places but rarely, if ever, submerged except at high water; growing intertangled with many different species of mosses of which various species of *Brachythecium*, *Calliergon stramineum*, *Dicranum Bonjeani* and *Oncophorus virens* are a few.

Found chiefly in cool shaded places in hills and mountains, northern U. S. and Canada across the continent, north to the arctic, south to the Gulf States according to Jennings but rare south of Pennsylvania in the East, Ohio, Colorado, Utah, N. Mexico and California. Very common where found and occurring in a great number of forms, of which only a portion of those that have been named are described here.

Forma *AURICULATUS* Moenkem. has inflated alar cells numerous, forming auricles. Glacier National Park, Montana, alt. about 5000 ft.

Var. *SYMMETRICUS* (R. & C.) Grout, Check List, 16. 1929.

Hypnum symmetricum R. & C. Bot. Gaz. 14: 99. 1889. Distinguished chiefly by the erect capsules, which are narrow and practically symmetric in typical plants. The type was described as having leaves less strongly and regularly plicate, entire or slightly denticulate; capsules sometimes two from the same perichaetium. Type from Oregon.

Forms with capsules erect and symmetric or nearly so are not rare in the northwestern U. S. from the Rocky Mts. westward and probably in adjacent Canada, but the leaf characters described for the type are not always correlated. Grout, N. Am. Musc. Pl. 207 has capsules nearly erect and symmetric. A specimen from Grand Gulf, Mt. Washington, N. Hampshire, is also referable to this variety.

***D. badius* may be sought here.

Var. *PLUMULOSUS* (Br. & Sch.) Roth, Europ. Laubm. 2: 551. 1905.

Hypnum uncinatum plumulosum Br. & Sch. l. c. figs. v 1 & 2.

Very slender and closely pinnate; leaves 2.4×0.6 mm., having shorter acumination and fewer plicae, less denticulate, sometimes nearly entire; seta shorter and capsule smaller. Probably throughout the range of the species. Grout, N. Am. Musc. Pl. 195.

Apparently a habitat form growing on bark of trees and rocks in shaded elevated regions.

Var. *plumosus* (Schimp.) Ren. is a similar form but larger; leaves with a long slender capillary acumination. Less frequent than var. *plumulosus* and of little importance. Grout, N. Am. Musc. Pl. 101.

Var. *polaris* (Ren.) as represented in the type from St. Matthew's Island, Alaska, is merely a very short (10-15 mm.) stunted arctic-alpine form; leaves smaller, less plicate and less serrate; leaf cells with thicker walls. Type duplicate seen. Also found on Pike's Peak, Colorado, at the summit, 14147 ft. altitude.

There are forms slender, forms robust with leaves less falcate [var. *subjulaceus* (Br. & Sch.) Grout]; forms with leaves entire [var. *fragilis* (Aust.)]; leaves less plicate as in var. *plumulosus*; also forms with varying lengths of seta and capsule but in nearly every case there are enough of the italicised characters present in some plants of a tuft to make identification with the species fairly easy and certain. This last, it seems to the author, is the function of a manual and not the niceties of varietal description appropriate to an extensive monograph.

2. DREPANOCLADUS VERNICOSUS (Lindb.) Warnst. Beih. Bot. Centralbl. 13: 397. 1903.

Hypnum vernicosum Lindb., Hartm. Skand. Fl. (Ed. 8) 17. 1861.

In deep intertangled tufts, yellow-green above, brown to reddish below; stems rather slender, ascending to erect, hooked at the ends with the falcate-secund leaves, 5-15 cm. long; branching subpinnate, at times distantly but almost regularly pinnate; central strand lacking; outer layer of stem cells small and thick-walled; stem leaves neither decurrent nor auricled, plicate, close, falcate-secund to circinate, lanceolate to ovate-lanceolate, often channelled at apex, ± 2.5 mm. long, 0.9-1.2 mm. broad, gradually and rather broadly acuminate, entire; costa extending beyond the middle of leaf; median leaf cells very narrow and flexuose, $5-6 \mu$ long, $8-15:1$; a row or two or more of basal cells shorter, broader thick-walled and colored, not different at basal angles; inner perichaetial leaves erect, sharply acuminate, plicate, with a long costa. Dioicous; capsules ovoid-cylindric, red-brown, cernuous, unsymmetric, $2.5-3 \times 1.2-1.5$ mm., strongly contracted under the mouth when dry; operculum conic-apiculate; annulus of 3 rows of cells, deciduous; peristome perfect. Spores infrequent, ripening in spring. Type locality European.

In swamps and wet places, northern U. S. and Canada, south to New Jersey, Pennsylvania and Ohio. Not common. Difficult at times to distinguish from *D. intermedius* without stem sections.

ILLUSTRATIONS.—Limpricht, Laubm. 3: 375. fig. 407; Dixon & Jam. Handb. Brit. Mosses, pl. 58E; M. H. M. f. 160 and pl. 71.

EXSICCATI.—Aust. Musc. Appal. 402; Allen, Mosses Cascade Mts. 134; Macoun Can. Musci. 384 in part (one specimen at the N. Y. Bot. Garden is *Cratoneuron falcatum*); Grout, N. Am. Musc. Pl. 391, 391a.

Very robust dark colored forms (often with a reddish tinge), with leaves less falcate, 3-4 mm. long are known as var. *major* (Lindb.) Warnst. = var. *turgidus* (Jur.) Moenkem.

3. DREPANOCLADUS REVOLVENS (Sw., C. Muell.) Warnst. Beih. Bot. Centralbl. 13. 402. 1903.

Hypnum revolvens Sw. Musc. Suec. 101, pl. 7, f. 14. 1799 and C. Muell. Syn. 2: 323. 1851 (not including synonyms).

Plants in deep soft tufts, deep red-purple to reddish black, variegated above with golden-green and orange; stems irregularly divided, unequally and not pinnately branched; stem section showing a small central strand and a single cuticular layer of larger hyaline cells; leaves large, $3-5 \times 0.6-1$ mm., densely crowded so that stems appear robust and tumid, not decurrent, strongly and regularly circinate, slightly or not at all plicate, longly and slenderly acuminate, widely oblong to lanceolate at base, entire or serrulate near apex, concave, canaliculate above; costa reaching $\frac{3}{4}$ the length of the leaf; leaf cells very long and narrowly linear-flexuose, about 6μ wide, $10-30:1$, or even longer according to Dixon, narrower towards the margin, uniform almost to the base; a few basal cells, about two rows, broader, shorter, thicker-walled, porose, and deeply colored, not different or decurrent at the angles, or with a few (1-4) somewhat inflated and hyaline. Autoicous or dioicous; seta 2-5 cm. long; capsule oblong-ovoid, unsymmetric, cernuous, 3-3.5 mm. long, about $3:1$; operculum conic-apiculate; annulus of two or three rows of cells; peristome perfect. Spores in spring; rarely produced.

Type locality Switzerland.

ILLUSTRATIONS.—Bry. Eur. *pl.* 601; Dixon & Jam. Handb. Brit. Mosses, *pl.* 58F. *Pl.* 28.

EXSICCATI.—Grout, N. Am. Musc. Pl. 97 and 159 (as *Hypnum capillifolium*).

In swamps, western U. S. and western Canada in the Rocky Mountain region from Colorado to Alaska and west to Vancouver Id. Rare.

Var. *Cossoni* (Schimp.) Ren. is a very robust form but otherwise scarcely distinguishable from typical *revolvens*. It varies greatly in size, sometimes almost as robust as *Scorpidium*, at others approaching *D. intermedium*. The form *Cossoni* occurs with the other forms in N. America but most recent authors do not think it worthy of even varietal rank.

Var. *MIQUELONENSIS* (Ren.) n. comb.

Hypnum scorpioides miquelonense Ren. in R. & C. Musc. Am. Sept. Exsic. 131.

Plants green at the tips, *dark brownish-purple below; outer layer of stem cells enlarged*; leaves strongly falcate-secund, oblong-lanceolate, subtubulose above, widest near the middle; costa very slender and faint, reaching $\frac{1}{2}$ the length of the leaf; leaf cells *exceedingly long and narrow, thick-walled*, the cell walls nearly as wide as the cell cavity. *Pl.* 26E, 4-6.

The above description applies to the leaves of the ultimate branches and seems to indicate clearly that this plant belongs here rather than with *Scorpidium* or *D. lycopodioides*. Renauld (Husnot, Musc. Gall., 394) says "A robust submerged form; . . . Stems 15-25 cm. long. Leaves of the principal branches subimbricate, somewhat secund, obtusely acuminate." He also states that the costa may be short and forked. Collected on the island of Miquelon by Dr. Delamare in a mixture of "*Hypnum scorpioides* and *lycopodioides*."

*4. DREPANOCLADUS INTERMEDIUS (Lindb.) Warnst. l. c.

Hypnum intermedium Lindb. Hartm. Skand. Fl. (Ed. 9) 17. 1864.

Subspecies of the last, often considered merely a variety. Differs from *D. revolvens* in the more slender stems and usually pale yellowish, or green color, often brownish below; leaves \pm 2 mm. long, not at all plicate, much more shortly acuminate, shaped much like those of *D. vernicosus*; leaf cells shorter, not so incrassate or colored at base; stem section as in *D. revolvens*. Dioicous.

ILLUSTRATIONS.—Dixon & Jam. Handb. Brit. Mosses, *pl.* 58; M. H. M. f. 161, p. 307.

EXSICCATI.—Grout, N. Am. Musc. Pl. 305; Sull. Musc. Allegh. 25 (as *Hypnum aduncum* var.); Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 314.

Bogs, Northern U. S. and Canada across the continent. Rare. Moxley collects in Bruce Co., Ontario, an interesting form with the leaf apex rather suddenly contracted to a short (0.2 mm.) filiform acumination.

5. DREPANOCLADUS BADIUS (Hartm.) Roth, Europ. Laubm. 2: 569. 1905.

Hypnum badium Hartm. Skand. Fl. (Ed. 5) 332. 1849.

Plants rather rigid, in loose deep tufts, *green to copper-colored above, dark red-brown to almost black below*; stems prostrate to erect, sparingly divided to branched, reaching 6 cm. or more in length; stem leaves rather close, broadly ovate, gradually narrowed to a rather slender acumination (sometimes rather abruptly narrowed to shorter acumination), *narrowed at base but not rounded or decurrent, very concave*, loosely imbricate and somewhat falcate-secund, entire, 1.2-1.5 \times 0.6-0.75 mm.; costa reaching $\frac{3}{4}$ the length of the leaf, often forking above; *median leaf cells 7 μ wide, 6-10 : 1, linear-flexuose, very thick-walled, porose; leaf cells becoming broader, shorter, thicker-walled, more porose and darker copper-colored at base; at basal angles a small group of still larger cells with still thicker walls*, part or all of which often remains attached to the stem upon removal of the leaf. Dioicous; capsules red-brown, 1.5-2 mm. long, somewhat contracted under the mouth when dry; operculum conic-apiculate to subrostrate. Type Scandinavian. Rare and subarctic. The American forms from Labrador, Allen, and the Yukon, Williams, have much larger leaves, reaching 2.2 \times 0.85 mm., much more abruptly narrowed to a rather short slender acumination.

The European authors that speak of the Greenland plants do not note this difference.

ILLUSTRATIONS.—Roth, l. c. *pl.* 59; Broth. Laubm. Fennosk. f. 92; *Pl.* 24E, 1-2.

6. DREPANOCLADUS LYCOPODIOIDES (Brid.) Warnst. Beih. Bot. Centralbl. 13: 400. 1903.

Hypnum lycopodioides Brid. Sp. Musc. 2: 227. 1812. emend. Schwaegr. Suppl. 1²: 300. 1816.

Very robust, resembling Scorpidium in the tumid stems with large rugose leaves, "of a rich golden color" (Dixon); stems simple or with few short branches, 10-30 cm. long; leaves usually crowded, *very large*, 3-6 \times 1.3-1.6 mm., very concave, falcate-secund, ovate-lanceolate to oblong-lanceolate, entire or rarely slightly denticulate above, tapering to a slender acumination of moderate length, *narrowed and rounded*

and very slightly decurrent at the wide broadly excavate base, when dry irregularly rugose and slightly plicate; costa narrow, 30–50 μ wide, reaching to the base of the acumination; median leaf cells linear, about 7 μ wide, 8–15 : 1; basal cells shorter, broader, thick-walled and porose; angular cells scarcely wider, rectangular to quadrate. Dioicous; seta 2–4 cm. long; capsules subcylindric and curved, 3.5 \times 0.9 mm.; operculum conic-apiculate; annulus of 3 rows of cells; peristome perfect. Spores in May.

Type locality European. Deep bogs and pools.

ILLUSTRATIONS.—Bry. Eur. pl. 613 and 614: Dixon & Jam. Handb. Brit. Mosses, pl. 58A; Pl. 26A.

Known from our region from Greenland and Miquelon Island only. A very striking species distinguished from *Wilsoni* by the more crowded leaves, which are plicate-rugose when dry, the much smaller, non-inflated alar cells, and costa narrower as a rule.

Var. *BREVIFOLIUS* (Berggren) C. Jensen, Meddel. om Groenl. 3: 322. 1887.

"Leaves short, slightly secund, broadly ovate, concave, smooth or lightly sulcate, more or less suddenly narrowed into the apex, which has inrolled margins." Greenland. Original description quoted. Apparently the same as the next species.

7. *DREPANOCLADUS BREVIFOLIUS* (Lindb.) Warnst. l. c. 416. 1903.

Hypnum brevifolium Lindb. Spitsb. Mossor 541. 1866.

Tufts golden yellow above, brown below; stem leaves from a narrower base broadly ovate to ovate-lanceolate, gradually short-acuminate 1.6–1.8 \times 0.8–0.9 mm., falcate-secund, concave and subtubulose above by the infolded entire margins, not plicate; costa various, even on the same plant, always thin, sometimes faint, sometimes double and forking, sometimes single and longer and reaching nearly or quite to the middle of the leaf; median leaf cells comparatively short, 6–8 μ wide, occasionally reaching 60 μ in length but usually shorter; cells at base broader and shorter, 2–3 : 1, thick-walled and often colored at the insertion; at basal angles a group of small quadrate cells and occasionally below these a row or two of slightly enlarged cells at the insertion. Sporophyte unknown. Type from Spitzbergen. Pl. 24E, figs. 4–6.

Fort Conger, N. Greenland by the Peary expedition in 1902, associated with *D. revolvens*, determined by Nils Bryhn; Baxter Island, arctic coast of Alaska, collected by the Canadian Arctic expedition in 1918.

Specimens of both American collections have been seen at the N. Y. Botanical Garden; also N. W. Greenland, Fram Expedition.

Moenkemeyer states (Laubm. Europ. 769) that all the plants he possesses "Under the names *Hypnum brevifolium* Lindb., *latinerne* Arn., *latifolium* Lindb. et Arn. from Siberia, Spitzbergen and Arctic America—belong to this variety (i. e. *D. lycopooides brevifolius*) or to *D. Sendtneri* and *Scorpidium scorpioides*."

The variable costa, often short and double, and the shorter and broader leaf cells seem to the author to indicate that the specimens studied are worthy of specific rank.

8. *DREPANOCLADUS ADUNCUS* (Hedw.) Warnst. Beih. Bot. Centralbl. 13: 400. 1903.

Hypnum aduncum Hedw. Musc. Frond. 4: 62. pl. 24. 1797 and Sp. Musc. 295. 1801.

Plants dark to yellowish green, brownish below, growing in soft loosely intertangled mats, or in some forms in rather dense tufts with slender upright secondary stems, in still other forms loosely floating; stems 2–3 cm. long in f. *tenuis*, to 30–40 cm. in f. *paternus*, irregularly to pinnately branching; stem leaves broadly triangular-ovate and acute to slenderly acuminate, or long-lanceolate and filiform-acuminate in aquatic forms, usually somewhat secund, especially at the ends of the stems and branches, often strongly falcate, entire, strongly excavate at base with large decurrent auricles of enlarged and strongly inflated cells, which are usually hyaline and may reach to the costa; median leaf cells linear-flexuose in most forms to oblong-hexagonal in var. *polycarpus*; leaf cells usually longer toward the apex and shorter towards the base; costa usually of medium size, extending to about the middle of the leaf, but short to double in f. *tenuis* and strong and excurrent in f. *capillifolius*; branch leaves smaller and often of shapes quite different from those of the stem, more often falcate and less often long-lanceolate; perichaetial leaves large, long-acuminate, slightly plicate, with a long slender costa. Dioicous; seta about 2.5 cm. long; capsule oblong, 2–2.5 mm. long, curved and cernuous; operculum conic-apiculate, annulus present; peristome perfect. Spores in summer.

Widely distributed throughout North America, especially in the northern two-thirds.

Captain Renaud says in Husnot, Musc. Gall. 369, "The variations of *Hypnum aduncum* are due both to climatic and geologic conditions," and suggests that in France the more slender typical forms are found in siliceous soils and the more robust *Kneiffii* and *polycarpus* forms on calcareous and clayey substrata. Accordingly collectors should note the type of soil on which these plants are found, especially as to its acidity or alkalinity.

D. aduncus has a series of forms paralleling those of *D. Sendtneri*. For the distinctions see under the latter species. *D. aduncus* is distinguished from *D. fluitans* by its broader entire leaves and in many forms by its broader and shorter leaf cells.

Not only is this species infinitely variable as to the structure and form of individual plants but leaves on the same stem may vary from long and slenderly lanceolate with narrowly linear cells to broadly ovate with broadly oblong-hexagonal cells. One plant had the broad short leaves at the top and bottom of the stem with the long and narrow leaves between. The lower leaves were probably the first leaves of the young stem, the middle leaves grew on a submerged portion, and the upper leaves on the emergent portion.

In general, as Schimper observes in his comments on *D. aduncus* in the supplement to the Bryologia Europea, the lower leaves of stem divisions and branches are broader and more cordate in outline than those elsewhere and have a shorter areolation. In other words the lower leaves of all forms are of the *polycarpus* type.

To attempt to describe all the numerous forms that have been given names would be out of place in a work of this nature but an attempt is made to describe the principal forms and to indicate their relationships.

In the descriptions and classification of this most polymorphous species the main object has been to make an intelligible arrangement of the forms and to give descriptions enabling the student to recognize the principal forms likely to be found. All manner of intergrading and intermediate forms occur which may be referred to one or the other of two related described forms without committing any taxonomic sin or stultifying the reputation of the student identifying the plant. Many specimens will best be classified as "approaching" or "near" the nearest described form.

The second objective has been to correlate the arrangement and the names used with previous literature. This has not been easy or certain as authors differ in the application of some of the names used. In the main the arrangement is that of Moenkemeyer in the "Laubmoose Europas" and the descriptions in the main are founded on the conceptions of Renauld, except in the case of var. *Kneiffii*.*

The main grouping given is based on the structure of well-developed leaves growing entirely out of water. All three of the groups treated below produce *pseudofluitans* forms when submerged and *capillifolius* forms under certain conditions not well understood, and it seems probable that these forms will all be found widely distributed in N. America.

KEY TO VARIETIES.

- | | |
|---|--------------------------|
| 1. Lower leaf cells linear..... | 2. |
| Lower leaf cells oblong-hexagonal..... | var. <i>polycarpus</i> . |
| 2. Stem leaves falcate-secund, lanceolate, channelled at apex..... | <i>aduncus typicus</i> . |
| Stem leaves little if at all falcate or secund except at ends of stem and branches, oblong-lanceolate to ovate-lanceolate, apex flat..... | var. <i>Kneiffii</i> . |

I. *D. ADUNCUS* *TYPICUS*. The form described by Hedwig and described from his type by various authors has leaves that are long and slenderly acuminate from a broadly lanceolate base, *little narrowed to the insertion*, more or less falcate-secund, especially those at the ends of the stems and branches; *apex channelled by the incurved upper leaf margins*; *median leaf cells narrowly linear*; only those cells near the insertion markedly broader and shorter; costa usually extending to about the leaf middle; inflated alar cells of the auricles numerous, often extending well toward the costa.

ILLUSTRATIONS.—Bry. Eur. *pl.* 604, and Suppl. Hypnum *pl.* 1; Husnot, Musc. Gall. *pl.* 105, figs. 4-7; Moenkem. Laubm. Europ. *f.* 171a; M. H. M. *pl.* 74, *f.* 1; *Pl.* 24D and 27Aa-b.

EXSICCATI.—Grout, N. Am. Musc. Pl. 249 (a lax form), 289 & 326, 433, 433a and 431 (an unusually large form approaching *D. Wilsoni* in appearance but with the alar cells of this species), 454 (approaching *f. aquaticus*).

Forma AQUATICUS (Sanio) Moenkem. A large submerged form; leaves reaching 3-4 mm. in length, distant, long-lanceolate, terminating in a long slender filiform acumination, falcate to twisted; median leaf cells long-linear. *Pl.* 27B. This is a submerged form that still keeps some of the *typicus* characters. Plants with *typicus* leaves above water also produce *pseudofluitans* submerged leaves. *Typicus* also produces *capillifolius* forms (*Pl.* 27A, g), usually in the submerged portions. N. Am. Musc. Pl. 426.

Forma PSEUDOSENDTNERI Ren. & Langeron has the strong costa and strongly falcate-secund leaves of *Sendtneri* but has a larger group of inflated alar cells and narrower median cells. It seems possible that the differences between *Sendtneri* and *aduncus* are largely brought about by habitat conditions.

*This has been made easier by a large series of specimens sent me by Renauld about 25 years ago when Mosses with Hand-lens and Microscope was being prepared.

II. Var. KNEIFFII (Br. & Sch.) Warnst. l. c.

Amblystegium Kneiffii Br. & Sch. Bry. Eur. fasc. 55-56, pl. 573. 1853.

Plants with the habit of *Leptodictyum riparium*, differing from the typical form in the broader leaves with a flat acumen, which is usually much shorter; the leaves are only slightly if at all secund even at the ends of stems and branches, broadly lanceolate to oblong-ovate; median leaf cells narrowly linear, slightly broader and shorter in the lower portion. Pl. 26F and Pl. 27A, c. N. Am. Musc. Pl. 461 (approaches f. *intermedius*).

Renauld, basing his opinion on plants which he considered the type form, considered var. *Kneiffii* nearer the var. *polycarpus* than the true *aduncus typicus*. Such, however, was not Schimper's conception; he figures the leaves a little shorter and broader than *aduncus*, sometimes slightly secund and occasionally somewhat channelled above; but he figures the lower leaf cells as narrowly oblong-linear and states specifically that these cells are narrower than those of *Amblystegium riparium*, with which he associated it in his genus *Amblystegium*.

Schimper in the supplement to the Bry. Eur. says that *Kneiffii* is nothing but a lax, often prostrate form of *aduncus* with leaves distinctly shorter and less regularly falcate.

I have followed Schimper and Moenkemeyer rather than Renauld in the treatment of this variety. The short secund leaves in M. H. M. pl. 74, f. 44 do not to my mind represent *Kneiffii* but a form of *polycarpus*.

Forma INTERMEDIUS (Br. & Sch.) Moenkem. seems to be a submerged form of *Kneiffii*, differing from *typicus aquaticus* chiefly in the non-falcate, little-contorted leaves with a shorter acumination. Leaves of the *intermedius* form frequently occur on plants bearing other leaves that cannot be distinguished from the *aquaticus* form except that they are not falcate or much twisted. N. Am. Musc. Pl. 216 & 188a. Pl. 27D and 27A, d.

Plants of this form are frequently indistinguishable from *Leptodictyum riparium* except by the inflated auricular cells.

Var. *Kneiffii* also produces submerged *pseudofluitans*, and *capillifolius* forms. N. Am. Musc. Pl. 246. Pl. 27A, g.

Forma PUNGENS (H. Muell.) Moenkem. Plants very slender, filiform, little branched, soft and loose (Moenkemeyer), rigid (Dixon); leaves subimbricate, oblong-ovate, apiculate to acuminate, the apical rolled together into a cuspidate point.

It seems probable that *Calliergidium pseudostramineum* and its forms are merely extreme *Kneiffii* forms. Moenkemeyer puts them with *D. fluitans* but the relatively broad entire leaves indicate a closer relationship to this species.

III. Var. POLYCARPUS (Bland.) Warnst. Laubm. Kryptogamenfl. Mark Brand. 1000. 1906.

Hypnum polycarpon Bland. in Sched. Voit. in Sturm. Deutschl. Fl. 2: Heft 14. 1813.

Tufts bright to brownish green; stems procumbent with numerous slender branches, not pinnate, 5-10 cm. long, longer in submerged forms; leaves rather distant, erect open, typically little falcate or secund (strongly so in some of its forms) except at the ends of stems and branches, broadly ovate to oblong-ovate, subcordate at base, rather shortly acuminate (except forms); branch leaves smaller and often secund; leaf cells, especially in the lower $\frac{1}{2}$ of the leaf much shorter and broader than in *typicus* or *Kneiffii*, oblong-hexagonal to oblong-linear; inflated alar cells usually large and numerous, forming large decurrent auricles; costa usually strong, reaching beyond the middle of the leaf. M. H. M. pl. 74, f. 2; Pl. 26D and 27A, i. N. Am. Musc. Pl. 181 & 188.

Forma ACANTHOCLADUS Moenkem. Filiform; parallel to *Kneiffii pungens*.

Forma FILICUSPIS Moenkem. Leaves with a slender acumination about $\frac{1}{2}$ the length of the rest of the leaf, often falcate to secund, (N. Am. Musc. Pl. 289 & 365) frequently producing *capillifolius* forms with excurrent costa.

Forma GRACILESCENS (Br. & Sch. Bry. Eur. pl. 605) Moenkem. l. c.

Hypnum conflatum C. M. & Kindb. Cat. Can. Pl. 6: 230. Type seen.

Slender, yellowish-green; often subpinnately branching; leaves strongly secund with a rather short channelled acumination. M. H. M. pl. 74, f. 10; Pl. 28A and 27Ak. N. Am. Musc. Pl. 365 & Suppl. 23; Suliv. & Lesq. Musc. Bor. Am. (Ed. 1) 316b. Its subforma *tenuis* is almost filiform with very small leaves having a very short costa; the midjet of the species, often only 1 cm. long. N. Am. Musc. Pl. Suppl. 20 is close to this form. Pl. 27A, l.

Forma UNCUS n. forma. Differs from typical var. *polycarpus* in having strongly secund leaves. It is like a large *gracilescens*. Some forms are extremely difficult to distinguish from *Cratoneuron filicinum* except for the lack of paraphyllia. Other forms are much like *D. Sendtneri* except for the much more inflated alar cells forming larger auricles. Type, Allen, Mosses Cascade Mts. 136.

Var. *polycarpus* produces both *intermedius* and *capillifolius* forms when submerged. Often these forms can be recognized as of *polycarpus* origin by the upper leaves, sometimes by the short broad leaf cells of the branch leaves. N. Am. Musc. Pl. 356 and 394 are *polycarpus-intermedius* forms; 183 approaches this form. The type of *Hypnum Jamesii-Macounii* Kindb. Ottawa Nat. 23: 153. 1909, is a *polycarpus-intermedius* form. Other plants issued as *Jamesii-Macounii* are something different.

Var. PSEUDOFLUITANS (Sanio) was originally described as a submerged form having lanceolate leaves with narrowly linear-flexuose cells and very large auricles, so that the leaf base is excavate into a semicircle, or in some cases into $\frac{2}{3}$ of a circle; auricular cells very large and much inflated, hyaline. This form is produced by all three main groups of *aduncus*, probably most frequently by the *typicus* group. M. H. M. pl. 74, f. 5; Pl. 27A, e.

There are cases in which all the leaves, the upper seemingly emergent, are of the *pseudofluitans* type; this is the one named by Sanio. But similar forms are produced in differing leaf outlines by all the *aduncus* varieties. In general *pseudofluitans*, *aquaticus* and *intermedius* are descriptive names for submerged forms derived from almost any of the 3 varieties.

Forma PATERNUS (Sanio) is the giant form usually referred to var. *pseudofluitans*, corresponding to the f. *giganteus* of *D. Sendtneri* var. *Wilsoni*. It reaches 30-40 cm. in length, often beautifully pinnate; leaves little falcate or secund, reaching 5 x 1.3 cm., usually somewhat smaller; they may be of the *intermedius* or *aquaticus* type. N. Am. Musc. Pl. 423; 423a approaches this form from an *aquaticus* base as also does Aust. Musc. Appal. 409 (as *aduncus giganteus*).

Forma CAPILLIFOLIUS (Warnst.) Moenkem. l. c.

Hypnum capillifolium Warnst. Bot. Zeit. 1877: 478.

Typically having the costa of all the leaves more or less excurrent, in some cases excurrent into a filiform point of considerable length. Not only most *aduncus* forms but most *Sendtneri* and many *fluitans* forms produce these *capillifolius* forms. Such are produced also by many *Hygroamblystegia* and by *Cratoneuron filicinum*. The *capillifolius* forms of *D. aduncus* are usually submerged, and often only a part of the leaves on a plant will have the excurrent costa. In other cases all of the leaves, including the emergent leaves, will have it. These emergent leaves will usually indicate the basic *aduncus* form which produced the *capillifolius* form in hand. Grout, N. Am. Musc. Pl. 187, 445 & 160, and Sull. & Lesq. Musc. Bor. Am. 316 are *aduncus-capillifolius* forms. (See M. H. M. pl. 74, f. 9.)

*9. DREPANOCLADUS SENDTNERI (Schimp.) Warnst. Beih. Bot. Centralbl. 13: 400. 1903.

Hypnum Sendtneri Schimp. Bry. Eur. Suppl., fasc. 3-4. *Hypnum* 2. pl. 2.

Plants 8-15 cm. long, golden to yellowish-green, brownish below; stems erect, sparingly divided; branching irregular to distantly subpinnate; leaves crowded, secund, often strongly falcate to almost circinate, strongly hooked at the tips of the stems and branches, somewhat twisted when dry, broadly lanceolate to ovate-lanceolate, 1.5-2.5 x 11 mm., slenderly acuminate, not plicate, entire; branch leaves similar but smaller; costa stout, 80-120 μ wide at base, usually extending into the acumen; median leaf cells 6-8 μ wide, 6-10:1, oblong to linear-flexuose; towards the leaf base the cells gradually grow broader and shorter with thicker walls, especially in the var. *gracilescens* and other short-leaved forms; angular cells more or less inflated and colored with usually thick walls except in young leaves. Dioicous; sporophyte as in *D. aduncus*. Spores rare, spring to summer.

ILLUSTRATIONS.—Schimp., l. c.; Limpr. Laubm. 3: f. 409; Pl. 25B.

EXSICCATI.—Grout, N. Am. Musc. Pl. 13; Aust. Musc. Appal. 404 (as *D. aduncus*).

The above description applies to forma *vulgaris* (Sanio) Moenkem., which is apparently the specific form described by Schimper, l. c.

In its various forms and varieties this species extends across the northern U. S. and Canada northwards, south to N. Carolina and California. It apparently grows in swamps, bogs and wet places containing lime. It parallels the forms of *D. aduncus* so closely and, according to Moenkemeyer, intergrades with it so frequently in its various forms that I am putting forth the hypothesis that it is merely a calcicolous form of that species. A similar difference has already been noted in the calcicolous *Hygroamblystegia*.

At any rate it will be helpful to consider *Sendtneri* and its varieties as a series of forms paralleling those of *aduncus*, differing from it in its larger size, darker color, more strongly falcate leaves, stronger

and longer costa, thicker cell walls, less enlarged alar cells which are usually deeply colored. The basal cells of *Sendtneri* are also often colored.

(According to Schimper's plate and Dixon's description the leaf cells are nearly uniform to the base, but I do not find this true except in the varieties with longer leaves and it does not agree with the descriptions of later continental authors.)

Forma *GRACILESCENS* Sanio. This parallels f. *gracilescens* of *D. aduncus polycarpus* and at times is difficult to distinguish from it. The costa is less than 0.05 mm. wide at base, reaching about the middle of the short, shortly acuminate leaves; enlarged alar cells relatively few, thick-walled and golden-brown. Big Bull Arm, Newfoundland (*Hypnum falcatum brevifolium* Kindb. Type collection seen.), Minnesota, N. Carolina, Vermont. Grout, Musci Perfecti 60. This American form may prove to be different from the European, as I have not been able to examine authentic European material.

It seems a quite distinct and recognizable form. It looks like a *Cratoneuron*, but has no paraphyllia. Some forms of *Campylium chrysophyllum* having the alar cells somewhat enlarged at the insertion approach it quite closely.

Forma *ARISTINERVIS* Moenkem. Laubm. Europ. 766, is the form having an excurrent costa. The costa may be excurrent in almost any form or variety of *Sendtneri*. Undoubtedly such forms were a part of *D. aduncus capillifolius* Warnst. N. Am. Musc. Pl. 246a, 332 and 459 are *aristinervis* forms of var. *Wilsoni*. These forms seem the most frequent of *capillifolius* forms in the West.

Var. *WILSONI* (Schimp.) Moenkem. in Pascher's Suesswasser fl. 14: 134. 1894 (as forma).

Hypnum Sendtneri var. *Wilsoni* Schimp., l. c. pl. 3.

Plants usually, probably always, submerged, *larger in every way*; stems 15-30 cm. long, less divided or branched in typical forms; leaves more distant, lanceolate and *very slenderly very long-acuminate*, 3-5 mm. long; angular cells fewer and less distinct; costa described by various authors as more slender than in *Sendtneri*, but Dixon and I find it usually as strong.

Schimper's original figures and description give the cells as broader and shorter toward the base, but I find them often almost uniform, except the last two or three rows, and such is the case in an "original" specimen from the type locality determined by Schimper himself and sent me by Renaud. Type locality, Southworth, England.

Grout, N. Am. Musc. Pl. 439 (as *D. Sendtneri*) is this variety, also 246a, 337 and 459. This variety seems to bear much the same relation to the species as *D. revolvens* does to its subspecies *intermedius*. In the first case it is the variety that has the long leaves, in *revolvens* it is the original species itself that has them.

Forma *GIGANTEUS* (Schimp.) Moenkem. l. c.

Hypnum giganteum Schimp. Syn. (Ed. 1) 612. 1860. *H. hamifolium* Schimp. Syn. (Ed. 2) 732.

Plants floating, very large, reaching 25 cm. in length, more or less pinnately branching; leaves large, reaching 4 x 0.9 mm., often somewhat plicate and rugose, usually strongly falcate-secund.

To this form I have referred all the large floating *Wilsoni* that have been called var. *americanus* Ren. and var. *hamatus*. Schimp.

Moenkemeyer refers Roell's 1242, 1430 & 1431 (which Renaud cites as *D. Wilsoni occidentalis* R. & C.) to a form of *aduncus*.

Sull. & Lesq. Musc. Bor. Am. 316c & 468; Aust. Musc. Appal. 408 & 409.

Budd's Lake, New Jersey, is the classical American locality. New England, New York, Minnesota, Colorado, Washington, Wisconsin.

Var. *Wilsoni* and its forms seem more frequent than the other forms of *Sendtneri*. All forms seem infrequent and local. They should be looked for in alkaline waters.

DREPANOCLADUS FLUITANS (L., Hedw.) Warnst. l. c. 404. 1903.

Hypnum fluitans L. Fl. Suec. (Ed. 2) 899. 1755, and Hedw. Sp. Musc. 296. 1801.

Plants soft and slender in most forms, yellowish-green, brown to reddish below, growing in inter-tangled mats, frequently aquatic and floating; stems prostrate, ascending or floating; branching irregular as a rule, in some cases pinnate; leaves more or less secund and falcate, usually narrower than in *D. aduncus*, narrowly lanceolate or oblong-lanceolate, very gradually tapering to a long flexuose acumination, 3-4 mm. long; narrow at base and widely but not deeply excavate, sometimes almost truncate and straight, more or less decurrent; margins more or less serrulate especially at the apex, plane and flat; costa single, reaching the middle of the leaf or beyond; leaf cells long, 100-120 μ , 20-30: 1, linear-flexuose, almost uniform to

the base; angular cells larger, oblong to rectangular, hyaline or colored, often not sharply delimited and frequently scarcely forming auricles, in other cases reaching well towards the costa. Autoicous; seta 5-10 cm. long, red; capsules oblong-cylindric and arcuate, cernuous; annulus lacking; peristome perfect; operculum conic-apiculate. Spores in early summer.

Type locality European.

EUFLUITANS Moenkem. l. c. (Group *Amphibium* of many authors).

Leaves rather distant and little falcate or secund except at the ends of the stems and branches, flexuose, narrow, distinctly serrate at apex, faintly so at base; angular cells not much enlarged forming a distinct group but not true auricles. This is the typical *fluitans*.

ILLUSTRATIONS.—Bry. Eur. pl. 602; M. H. M. pl. 73.

EXSICCATI.—Grout, N. Am. Musc. Pl. 276 & 408; Allen, Mosses Cascade Mts. 137 (as var. *brachydictyon*).

A plant of lower elevations, apparently common, in some of its forms at least, in most sections of the northern U. S. and Canada.

Forma JEANBERNATI (Ren.) Moenkem. Leaves oblong-lanceolate, comparatively wide and comparatively short-acuminate; angular cells poorly delimited and relatively inconspicuous. Apparently a common form. M. H. M. pl. 74, figs. 12 & 13. Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 315. This includes var. *paludosus* Sanio, f. *terrestris* Sanio and f. *condensatus* Sanio.

Subf. *atlanticus* Ren. Stems nearly simple; leaves a little wider below; leaf cells broader, 10-12 wide in the lower leaf. Dixon considers this a degenerate or undeveloped form of f. *Jeanbernati* and I am unable to distinguish the Mt. Mansfield, Vermont specimen (N. Am. Musc. Pl. 103) determined by Renauld, from f. *Jeanbernati*. Forma *elata* (Ren. & Card.) Moenkem. l. c. is only a robust *Jeanbernati*.

Forma GRACILIS (Boul.) is a very slender form, little branched; leaves distant, narrow, with a long slender acumination, strongly serrate; alar cells somewhat inflated but rather poorly delimited. M. H. M. pl. 74, f. 14; N. Am. Musc. Pl. 153 & 153a. This should include var. *Delemarei* R. & C. Musc. Am. Sept. Exsic. 133, as the differences are very slight.

Forma SETIFORMIS (Ren.) Moenkem. This seems to be merely a large more robust form of much the same structure as f. *gracilis* but having large well-developed auricles almost large enough at times to qualify for *D. exannulatus*, Pl. 29A, l. Moenkemeyer, l. c., has apparently combined the two under f. *setiformis*. N. Am. Musc. Pl. 277 and 341 (as var. *Jeanbernati*). These two forms (*gracilis* and *setiformis*) are apparently common around the edges of pools and ponds subject to great fluctuations of depth. I have referred to these two forms and to f. *submersus*, plants whose upper leaves at least were rather strongly falcate-secund but otherwise correspond to the European descriptions.

Forma SUBMERSUS is a floating form, little branched as a rule but occasionally subpinnate; leaves distant, slightly or not at all falcate, long and slenderly acuminate (less so than f. *setiformis*) from a rather broad base; alar cells broader and shorter, but slightly differentiated, not sharply delimited. Pl. 29A, 2.

Aust. Musc. Appal. 410 (this is close to f. *setiformis*); N. Am. Musc. Pl. 285 (as var. *pinnatus* Boul.). This last is intermediate between f. *submersus* and var. *falcatus*.

Var. FALCATUS (Br. & Sch.) Roth. More robust, yellowish to red above, often a deep red-brown below; leaves usually strongly falcate, strongly hooked at stem and branch ends, more or less truncate at insertion, rather shortly acuminate; basal cells incrassate; costa stronger; auricles usually developed and formed of inflated cells.

M. H. M. pl. 73, β, figs. 1 & 2; pl. 74, f. 6; Pl. 29A, f. 3. N. Am. Musc. Pl. 104.

Apparently not rare at high altitudes on wet rocks. Likely to be mistaken for *D. revolvens*, from which it is distinguished by its denticulate leaf-apex and inflated alar cells.

*11. DREFANOCLADUS EXANNULATUS (Guemb.) Warnst. l. c. 405.

Hypnum exannulatum Guemb. Bry. Eur., fasc. 57-61. 34. pl. 603. 1854.

Subspecies of *D. fluitans* from which it differs chiefly as follows. Tufts usually more compact, more pinnately branched, more often purplish below; leaves typically broader at base, ovate-lanceolate, more shortly acuminate and more strongly falcate (except in the case of *fluitans falcatus*), often lightly striate when dry; costa stronger, often nearly percurrent; in nearly all forms a much larger group of inflated and hyaline auricular cells, usually reaching the costa and forming large decurrent auricles. Frequently dioicous.

Type locality European.

ILLUSTRATIONS.—Bry. Eur. l. c.; Dixon and Jam. Handb. Brit. Mosses pl. 58C; M. H. M. pl. 74, figs. 7, 8 & 16.

EXSICCATI.—Aust. Musc. Appal. 403; Grout, N. Am. Musc. Pl. 159 and 444, also Suppl. 14.

Northern U. S. and Canada across the continent, south to New Jersey, Pennsylvania and Colorado. Various intermediate forms between this and *D. fluitans*, and between the various forms described are frequent and puzzling.

The description above is intended to include *f. pinnatus* (Boulay) and *f. falcatus* Moenkem. as well as the typical form. All of these have very long and narrow leaf cells as contrasted with var. *brachydictyus*.

Forma *orthophyllum* Moenkem. has straight leaves; *f. obtusus* Moenkem. has at least a portion of its leaves obtuse; *f. tenuis* Moenkem. is an exceedingly slender, almost filiform plant.

Var. *ROTAE* (DeNot.). Leaves often purplish to brown, narrower, very longly filiform-acuminate, reaching 4–5 mm. in length, denticulate; costa from nearly percurrent to long-excurrent; leaf cells very long and narrow, 4–6 μ wide and 10–20:1. Pocono Mts., Pennsylvania; California.

Forma *SUBMERSUS* Moenkem. is a very long slender floating form, sometimes filling the water to a depth of 6–8 feet. It has an unusually large group of inflated alar cells. It is a parallel form to *D. fluitans submersus* and *D. aduncus aquaticus*.

Forma *FALCIFOLIUS* (Ren.) is much like *f. submersus* in leaf outline but the leaves are usually much more falcate with a smaller group of inflated alar cells, which are usually in a single row and somewhat incrassate. The plants are usually more or less regularly pinnate. *Pl. 29C*. N. Am. Musc. Pl. 347.

Forma *submersus pinnatus* Moenkem. is one of the most striking mosses known to the author. It is long and floating, reaching 30 cm. or more in length, plumose with the long pinnately arranged branches, making fronds 3–4 cm. wide. At first sight it reminds one of an aquatic flowering plant with finely pinatifid leaves. An excellent example was collected in Alaska by Howell (Pacific Coast Plants No. 1811 in the herbarium of the N. Y. Botanical Garden).

The costa in var. *rotae* is often excurrent, corresponding to the *capillifolius* forms of *D. aduncus*. All the varieties of *exannulatus* occasionally produce leaves with excurrent costa. But this happens much more frequently in the var. *rotae*.

Var. *BRACHYDICTYUS* (Ren.) Grout, M. H. M. 311. 1908.

Plants usually green, occasionally reddish, softer and less regularly pinnate than the preceding forms of *exannulatus*; leaves also much shorter and more shortly acuminate, less serrate, often almost entire; leaf cells much shorter but little broader, 6–7 μ wide, 5–9:1; costa usually very strong, 0.07–0.10 mm. wide, reaching well into the acumination, occasionally percurrent or even excurrent; auricles of inflated cells well developed but usually rather smaller than in most other forms of *exannulatus*. Type European, probably French. M. H. M. f. 162.

In marshy places and edges of peat-bordered lakes; arctic-alpine. Mt. Washington, N. H., alt. 5500 ft.; near Sperry Glacier and Lake Macdonald, Montana, Holzinger; Jasper National Park, Alberta, MacFadden.

Forma *TUNDRAE* (Arnell) Moenkem. l. c.

Amblystegium tundrae Arnell, K. Sv. Vet.-Ak. Handl. 23¹⁰: 128. 1890.

Hypnum amblyphyllum Williams, Bull. N. Y. Bot. Gard. 2: 139. pl. 24. 1901. (Type seen).

Leaves shorter, slightly secund at ends of stem and branches, sometimes slightly plicate, often obtuse and subcucullate at apex; apex occasionally inflexed; Dawson, Yukon Terr., in fruit. Williams. *Pl. 29B*.

The author has not seen authentic specimens of *A. tundrae* but has compared type specimens of *H. amblyphyllum* carefully with descriptions and figures of *tundrae*. This seems to be a rare reduced arctic form.

**DREPANOCLADUS BERGGRENII* (C. Jens.) Broth. Engler & Prantl, Musci (Ed. 2), 2: 344.

Harpidium fluitans **Berggrenii* C. Jens. Meddel. om Groenl. 3: 6. 1887.

Tufts yellow-green, brown below; stems flexuose, sparingly branched; lower leaves from a broadly ovate base shortly and obtusely acuminate, with incurved margins, somewhat falcate-secund, entire or distantly and faintly serrulate at apex; median stem leaves $\pm 0.6 \times 1.4$ mm.; costa scarcely reaching the middle of the leaf, often forking; median leaf cells rather long and slender, $\pm 8 \times 68 \mu$, rather thick-walled, flexuose; cells at the basal angles short-rectangular, incrassate, colored, very few inflated; inner perichaetial leaves entire, with costa short or wanting. Autoicous; capsule on a long slender seta, erect to somewhat cernuous, about 2×0.75 mm., short-ovoid; annulus lacking. Type from Greenland studied through the courtesy of Dr. Jensen.

Differs from *D. fluitans typicus* chiefly in being more slender, with smaller and relatively shorter leaves; costa scarcely reaching the middle of the leaf, often bifid; leaf cells with thicker walls; capsules suberect.

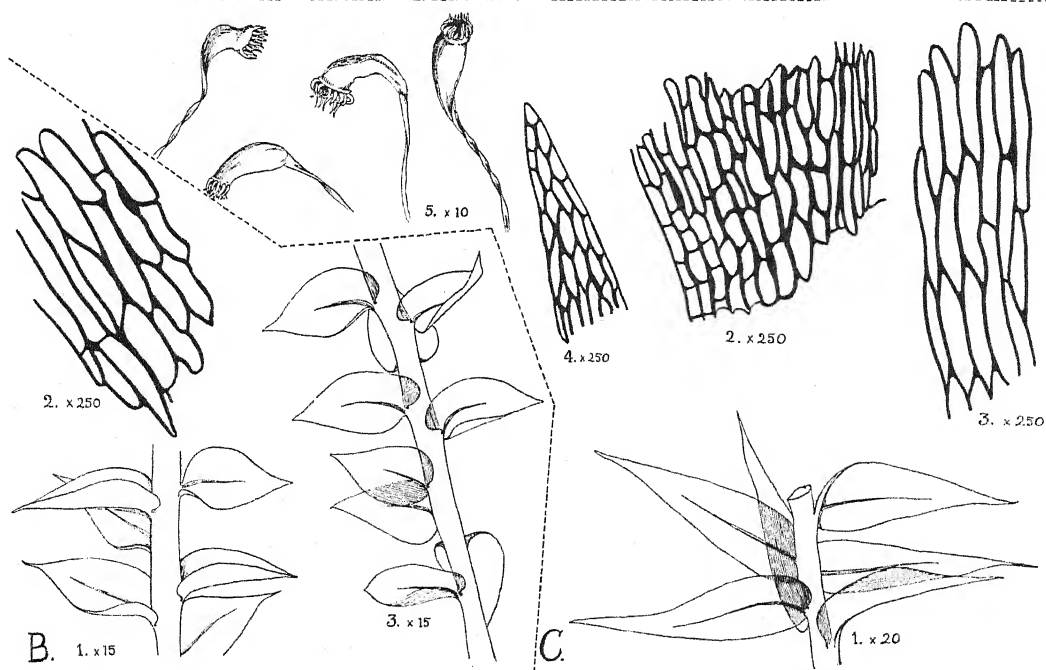
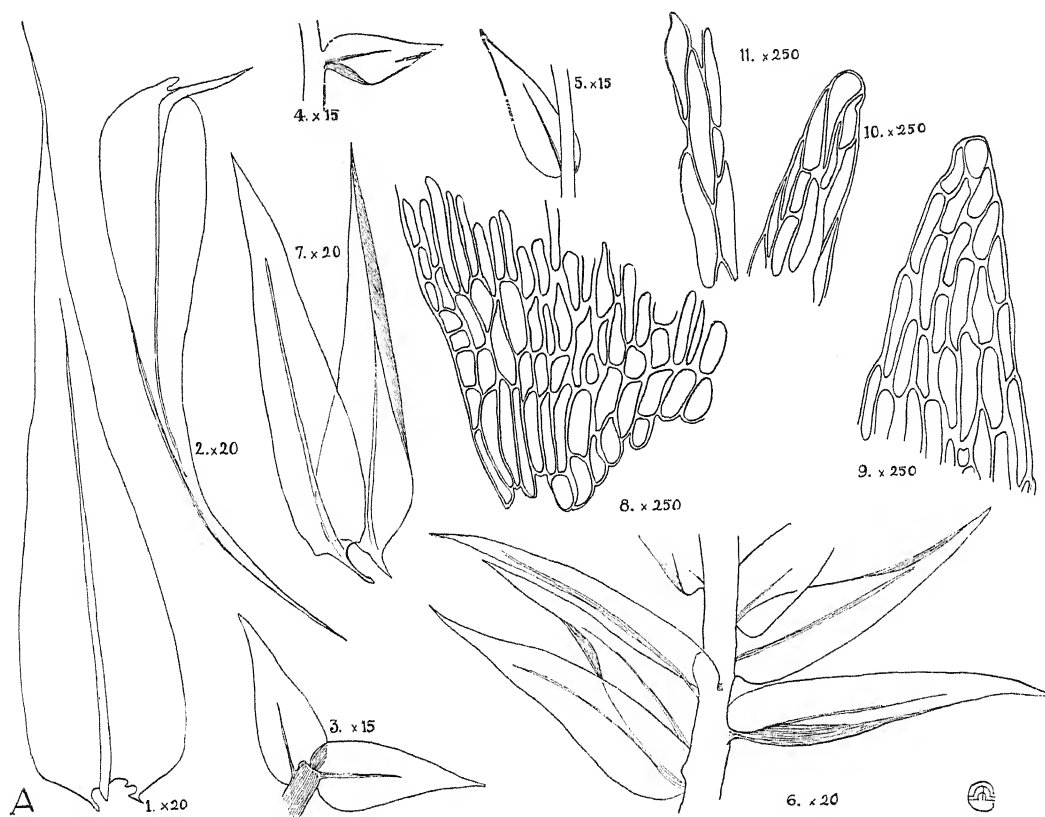


PLATE XV.

PLATE 15. A, 1, leaf of *Leptodictyum riparium longifolium*; 2, leaf of the same from an English specimen; 3, leaves of the broad-leaved *L. riparium* from Indiana, Welch; 4, emergent branch leaf and 5, submerged stem leaf of the same plant from N. Am. Musc. Pl. 295; 11, median cells of 4; 6, stem with leaves of *L. riparium*; 7, two leaves of *L. riparium obtusum*; 8, basal angular cells of the same, 9 and 10, apex and apical cells; Figs. 7-10 from N. Am. Musc. Pl. 471.

B, 1, stem and leaves of *L. brevipes*, Sheldon, no. 2343; 2, median cells of the same; 3, *L. brevipes*, Iowa, Conard.

C, *L. sipho*, N. Am. Musc. Pl. 248; 1, stem and leaves; 2, 3 and 4, angular, median, and apical cells; 5, capsules. All figures on this plate except C5 made with camera lucida.

PLATE 16. Fig. 1, *Leptodictyum riparium flaccidum* (from Jennings, Mosses W. Pa. pl. 38 (by permission); *p*, plant natural size; *y*, portion of stem; *z*, leaves; *a*, apical cells of leaves; *b*, basal cells; *c*, median cells.

Fig. 2, *Leptodictyum brevipes* (from Minnesota Bot. Stud. 3²: pl. 20); *a*, entire plant $\times 1$; *b*, leaves $\times 26$; *c*, perichaetial leaf $\times 26$; *d*, basal areolation of leaf $\times 195$; *e*, areolation in the middle $\times 195$; *f*, areolation of the upper part $\times 195$; *g*, capsule in the dry state $\times 13$; *h*, the same moist $\times 13$; *i*, operculum $\times 13$.

Fig. 3. (*a* brachy) *Leptodictyum riparium brachyphyllum* (from Minn. Bot. Stud. 3²: pl. 20); *a*, plant $\times 1$; *b*, leaf $\times 26$; *d*, median cells $\times 195$.

Fig. 4, *H. irriguum spinifolium* (drawn from N. Am. Musc. Pl. 438); *a*, lower stem leaf; *b*, upper leaf from the same stem; *c*, leaf from another stem from the same tuft.

Fig. 5, *a* and *b*, *Amblystegium varium lancifolium*, stem leaves from the type.

Fig. 6, *Hypnum sipho* P. B., Carolina, Bosc (from a specimen in herb. Schwaegr.); *a*, two leaves $\times 30$; *b*, capsule $\times 14$.

Fig. 7, *Amblystegium floridanum* R. & C. *a*, two leaves $\times 30$; *b*, capsule $\times 14$. (From an original specimen collected in Florida by Fitzgerald); *c*, two leaves $\times 30$; *d*, capsule $\times 14$. (From a specimen collected in Louisiana by Langlois, R. & C. Musc. Am. Sept. Exs. 129.)

Figs. 6 and 7, from Revision des types Hedwig et de Schwaegrichen by J. Cardot, Bull. Herb. Boissier 7: pl. 10. 1899.

Fig. 8, *A. varium ovatum*; *a*, portion of stem of Austin's 377 $\times 3$; *b*, leaf.

Fig. 9, *Hygroamblystegium irriguum marianopolitanum* from Minnesota, Holzinger; *a*, stem leaf $\times 22$ and median cells $\times 90$; *b*, branch leaf $\times 22$ and median cells $\times 90$.

Fig. 10, *Amblystegium varium laxum*, Indiana, Deam.

Fig. 11, *A. Juratzkanum*, *a*, stem leaf of plant from Berlin, comm. Loeske; *b*, basal angular cells of same; *c*, same cells from var. *giganteum*.

Fig. 12, two leaves of *Lepidictyum trichopodium*.

Fig. 13, *a*, two leaves *Hygroamblystegium fluviale ovatum*.

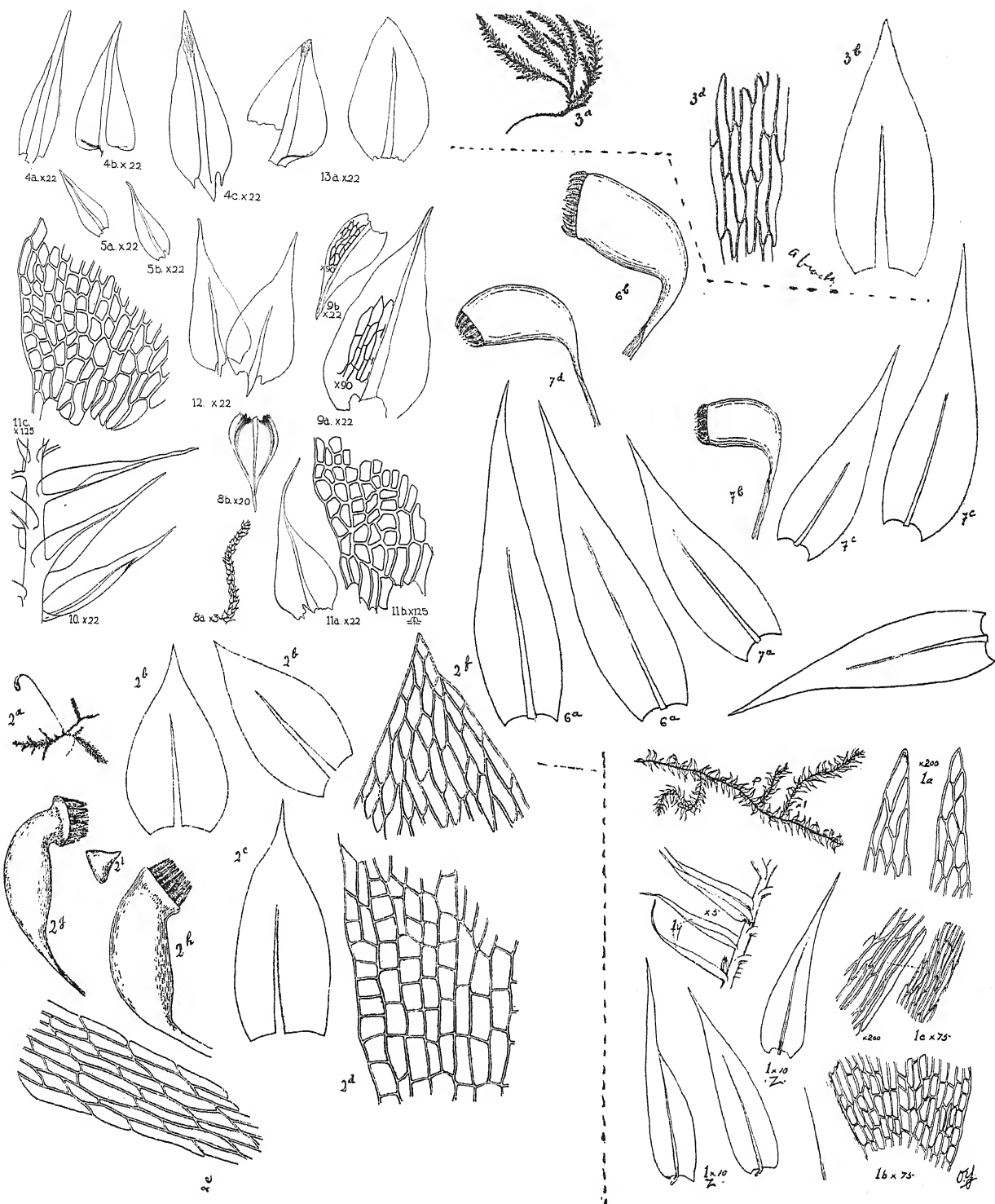


PLATE XVI.

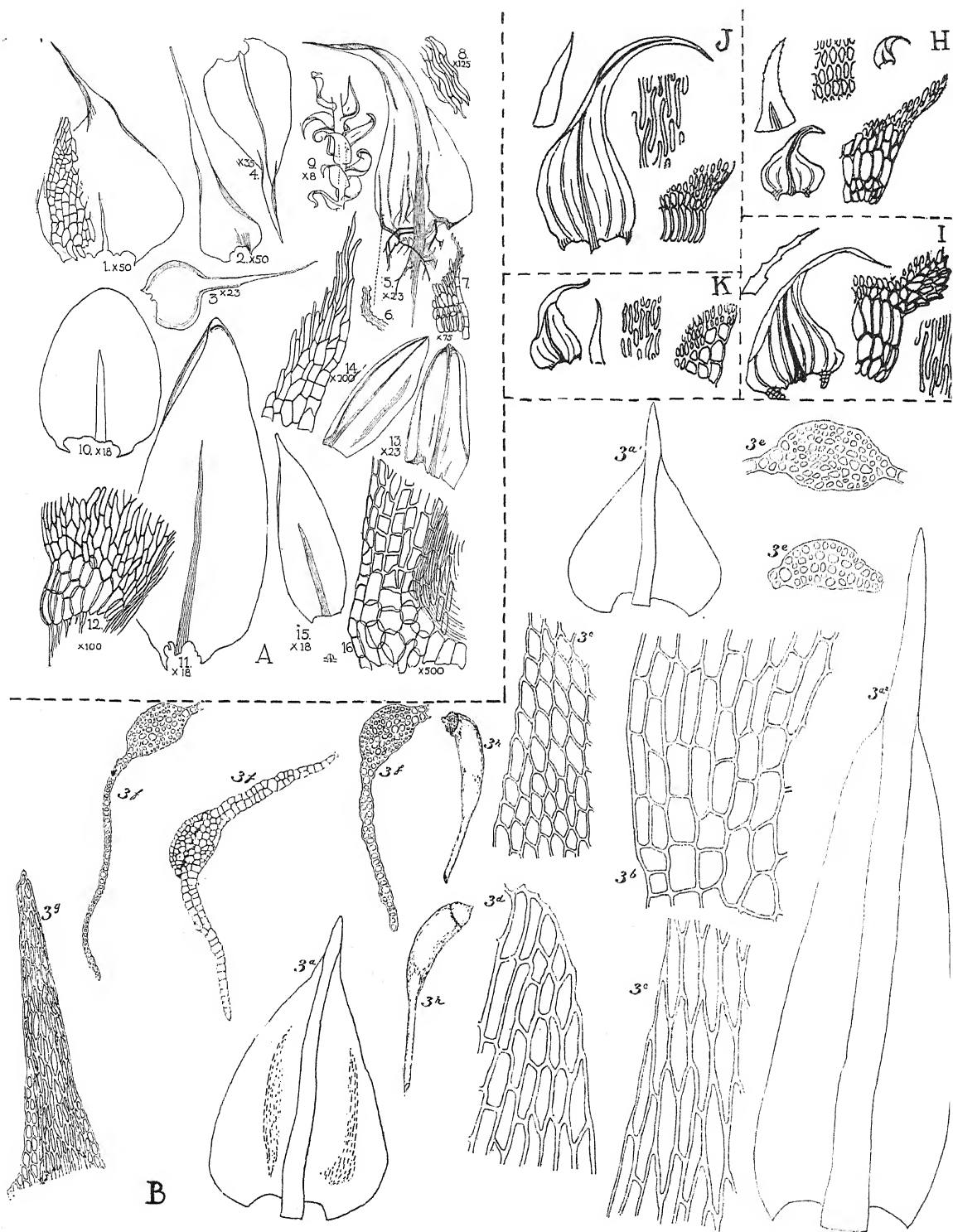


PLATE XVII.

PLATE 17. A. Fig. 1, stem leaf *Campylium hispidulum cordatum* (from the type) and the basal angular areolation $\times 80$; 2, stem leaf of var. *Sommerfeltii*; 3, stem leaf of *C. stellatum protensum* (note that it is magnified only $\frac{1}{2}$ as much as fig. 2); 4, stem leaf of *C. polygamum fluitans*: figs. 5-9, *Cratoneuron papillosum* from type specimens; 5, stem leaf; 6, ventral fold showing papillae; 7, alar cells; 8, median leaf cells; 9, portion of stem: figs. 10-12, *Calliergon Richardsoni*; 10, leaf from Mitten's type; 11, leaf from plant collected by Cooper on Isle Royale, Michigan; 12, alar cells: 13-14, *Hygrohypnum polare*; 13, two leaves; 14, alar cells: 15-16, *Calliergidium pseudostramineum Hoveyi* from the type, 15, leaf; 16, alar cells $\times 250$ (not 500).

B. *Hygroamblystegium noterophilum* after Cheney, Bot. Gaz. 24: pl. 12. *a* and *a'*, leaves, terrestrial form $\times 85$; *a''*, leaf, large aquatic form $\times 85$; *b*, *c*, and *d*, cells respectively from the alar, middle border and apical region $\times 580$; *e*, cells from the middle border region of the terrestrial form $\times 580$; *f*, cross-sections of the costa at the middle of the leaf and just above the lamina $\times 160$; *g*, cross-sections of the leaf; *h*, tip of leaf of the large aquatic form; *i*, capsule.

H, *Cratoneuron decipiens*; *I*, *C. commutatum*; *J*, *C. falcatum*; *K*, *C. sulcatum* (*H*, *I*, *J*, and *K* from Dixon and Jam. Handb. Brit. Mosses); all leaves $\times 15$; apices $\times 60$; median leaf cells $\times 180$; alar cells $\times 90$.

PLATE 18. Figs. 1-9, *Campylium Halleri* (from Bry. Eur. pl. 581). 1b, portion of a plant $\times 10$; 4-5, stem leaves; 2, 3, 7 and 8, branch leaves; 9, perichaetial leaf. All leaves highly magnified.

Figs. 13-18, *Campylium arcticum*. 13, plant $\times 6$; 14, 15, stem leaves $\times 19$; 16, branch leaf $\times 19$; 17, basal leaf cells $\times 210$; 18, median leaf cells $\times 245$.

Figs. 13-18 are from the original illustrations by Williams, Rept. Can. Arctic Exped. pl. 15E, to accompany the original description.

Figs. 4a-4d, *Campylium Cardoti* (from Bot. Gaz. 30: pl. 11), a, entire plant $\times 1$; b, b, b, leaves $\times 32$; d, capsule $\times 13$.

Figs. 5a-5e, *Campylium Treleasei* (from Proc. Wash. Acad. Sci. 4: pl. 22). a, entire plant $\times 1$; b, b, b, leaves $\times 26$; d, basal areolation of leaf $\times 270$; e, median leaf cells $\times 270$.

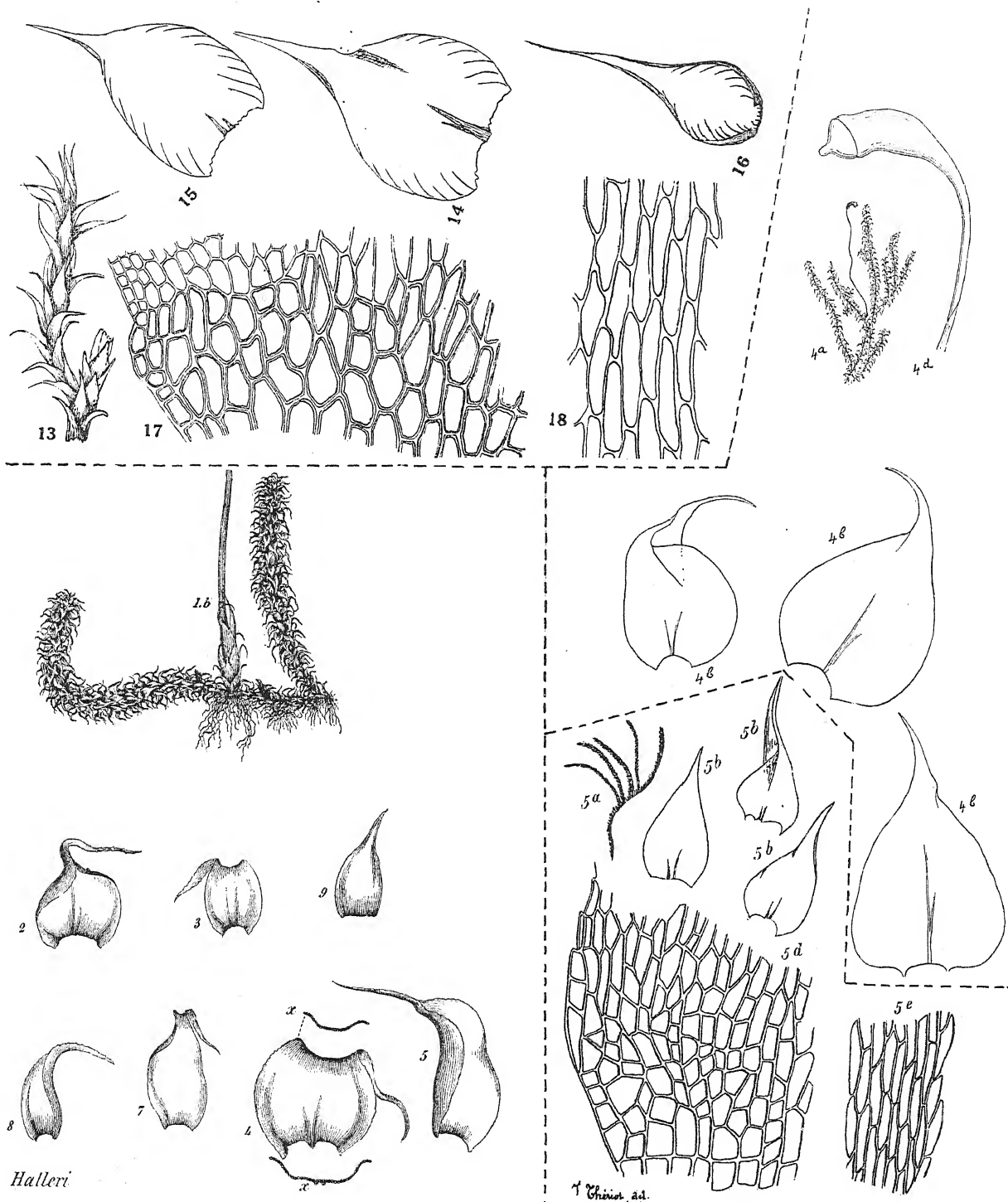


PLATE XVIII.

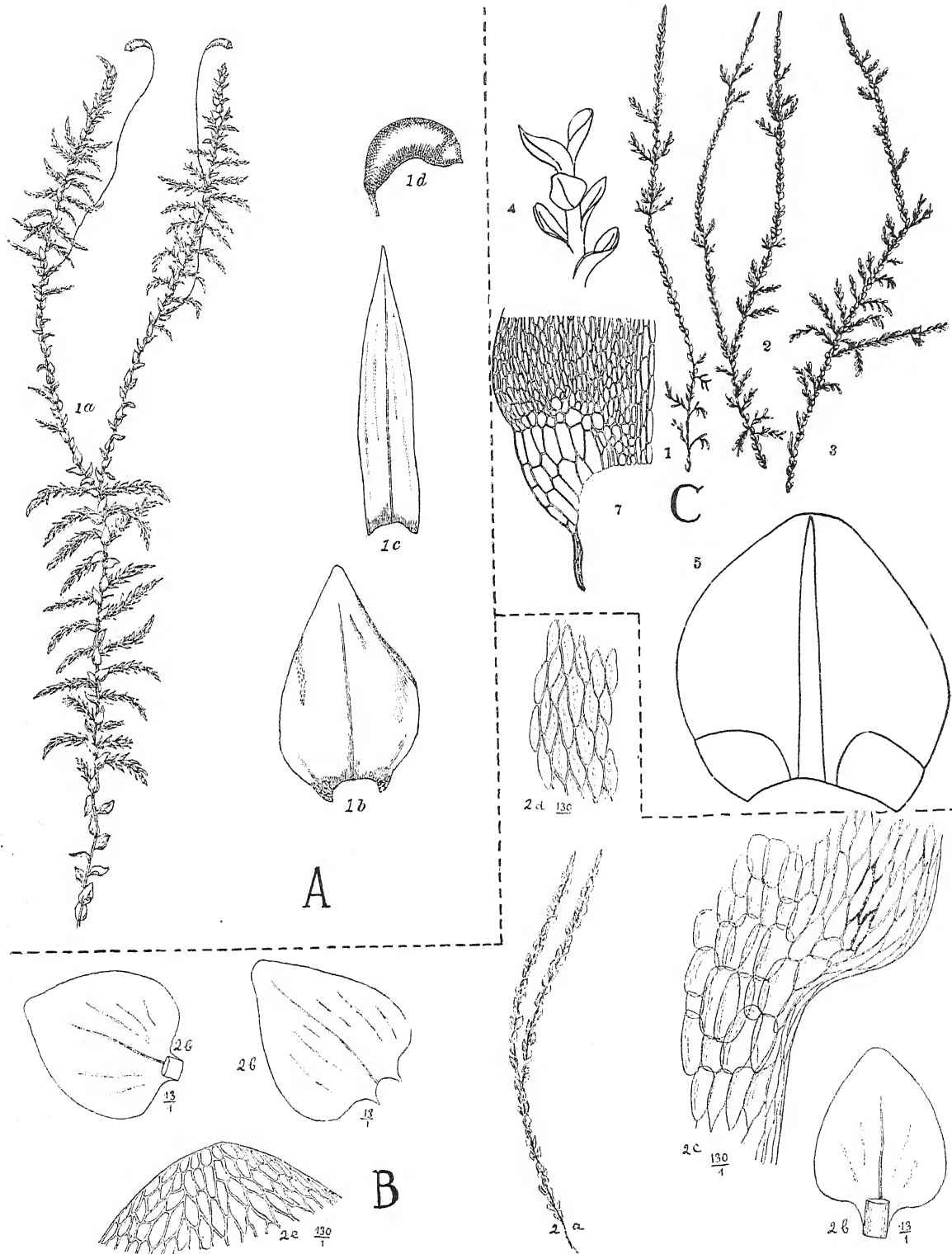


PLATE XIX.

PLATE 19. A. *Calliergon giganteum* (from Limpr. Laubm. 3: fig. 432). 1a, plant $\times \frac{3}{4}$; 1b, stem leaf $\times 15$; 1c, perichaetial leaf $\times 15$; 1d, capsule $\times 8$.

B. *Calliergon orbiculari-cordatum* (from Bot. Gaz. 22: pl. 4); a, entire plant; b, b, leaves; c, basal areolation of leaf; d, median leaf cells; e, apical leaf cells. The costa is very rarely as short as is shown in two of the leaves.

C. *Calliergon giganteum cyclophyllotum*; 1, 2, 3, plants $\times 1$; 4, portion of stem enlarged to show leaf arrangement; 5, stem leaf $\times 56$; 7, angular cells $\times 56$ (from Minn. Bot. Stud. Bull. 9: pl. 39).

PLATE 20. *Calliergon sarmentosum*. 1b and 2b, portions of stem enlarged; 3-8, stem leaves; 10 and 11, branch leaves; 3a, 4a, 4b and 8a, portions of leaves more highly magnified to show details (from Bry. Eur. pl. 616).

Calliergon stramineum. 2b, portion of stem enlarged; 3-6, stem leaves; 7, branch leaf; 4a, 4b and 6a, portions of leaves more highly magnified to show details; 8, 9 and 10, antheridial bud and perigonial leaves (from Bryol. Eur. pl. 617).

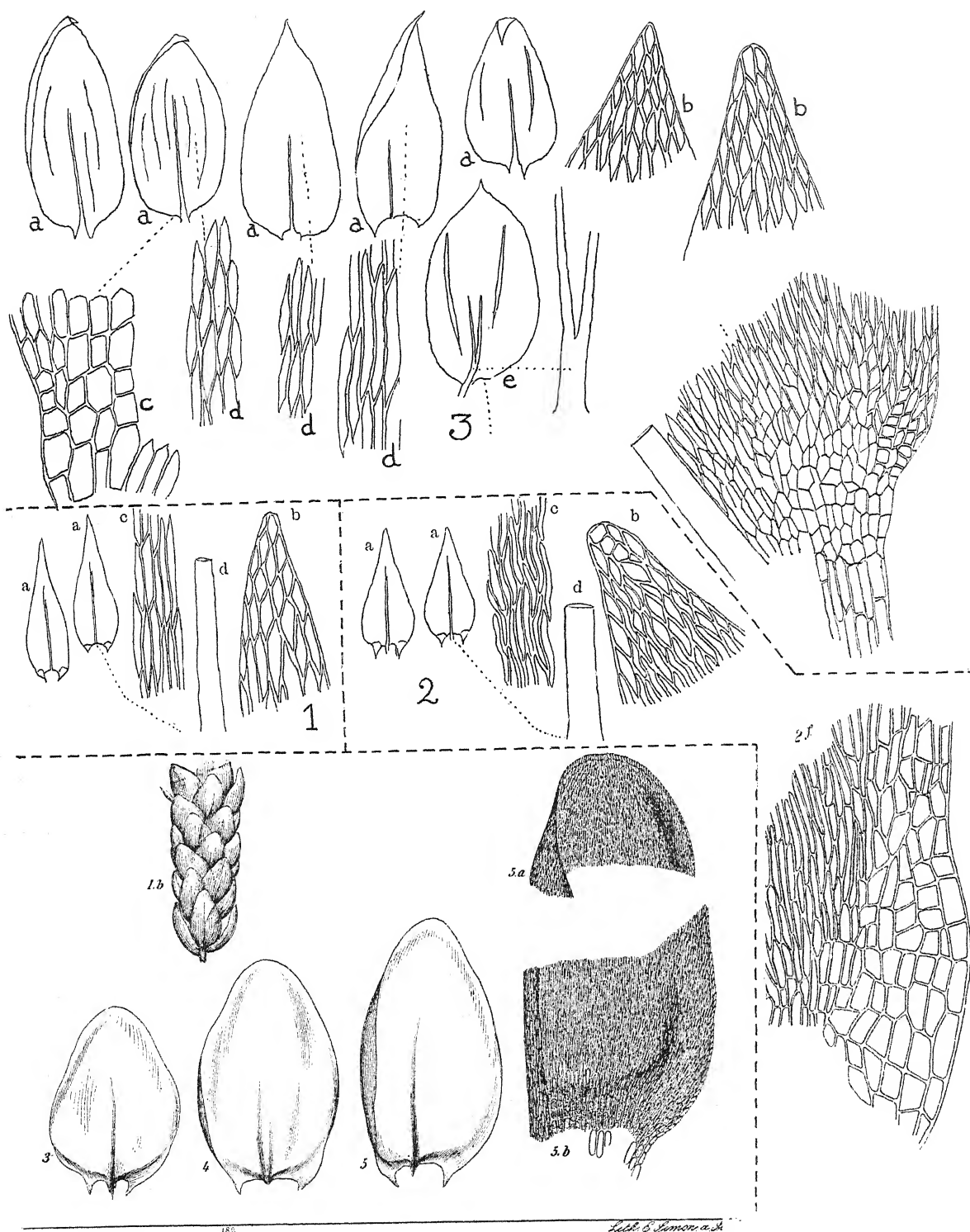


PLATE XXI.

PLATE 21. Figs. 1b-5b (lower left) *Calliergon trifarium*. 1b, portion of stem enlarged; 3-5, leaves; 5a and 5b, apex and base of leaf respectively, greatly enlarged to show details (from Bry. Eur. pl. 618).

1. *Calliergidium pseudostramineum*. a, a, stem leaves $\times 16$; b, apical cells $\times 200$; c, median leaf cells $\times 200$; d, basal part of costa $\times 120$.

2. *C. pseudostramineum* var. *plesistramineum*. a, a, stem leaves $\times 16$; b, apical cells $\times 200$; c, median leaf cells $\times 200$; d, base of costa $\times 120$; $\times 2f$, angular leaf cells $\times 225$.

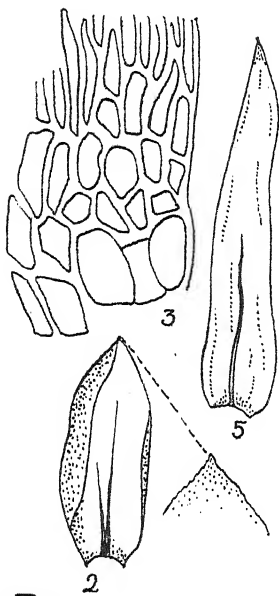
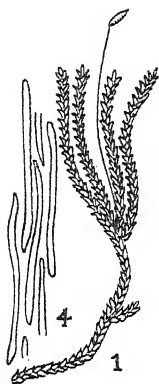
3. *Calliergidium Bakeri*. a, a, a, a, a, and e, leaves $\times 18$; b, b, leaf apices $\times 225$; c, alar cells $\times 225$; d, d, d, median leaf cells from different leaves as indicated $\times 225$; the unlettered figure at the right illustrates the basal and alar cells of leaf e $\times 140$. All figures in 1, 2 and 3 except 2f are from the Bryologist 4: plates 7 and 8. 2f is from Vol. 4, pl. 23 of Proc. Wash. Acad. Sci.

PLATE 22. A. *Hygrohypnum subeugyrium* (from Bot. Gaz. 22: pl. 5) a; entire plant; b, b, b, stem leaves; c, d, and e, angular, median and apical leaf cells respectively.

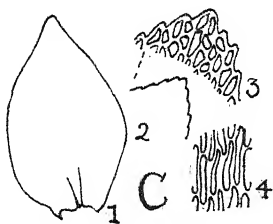
B. *Hygrohypnum montanum* (from Sull. Icon. Musc. pl. 113); 1, branch, enlarged; 3, 4, 5 and 6, branch leaves; 7, basal areolation; 8 and 9, apical areolation.

C. *Hygrohypnum molle* (from Dixon & Jam. Handb. Brit. Mosses pl. 59N). 1, leaf $\times 15$; 2, leaf apex $\times 60$; 3, apical cells $\times 180$; 4, median cells $\times 180$.

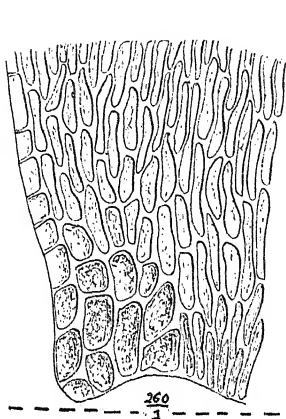
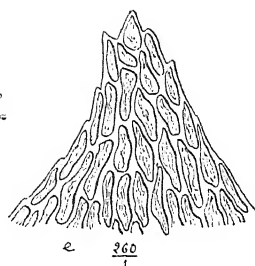
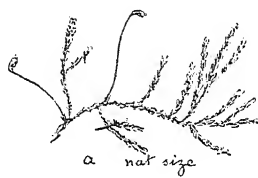
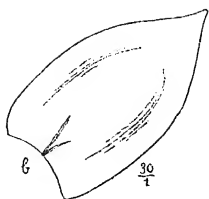
D. *Hygrohypnum alpestre* (from Husnot, Musc. Gall. pl. 119). 1, plant $\times 1$; 2, leaf much enlarged with leaf apex still more magnified; 3, angular leaf cells; 4, median leaf cells; 5, perichaetial leaf.



D



C



A



B

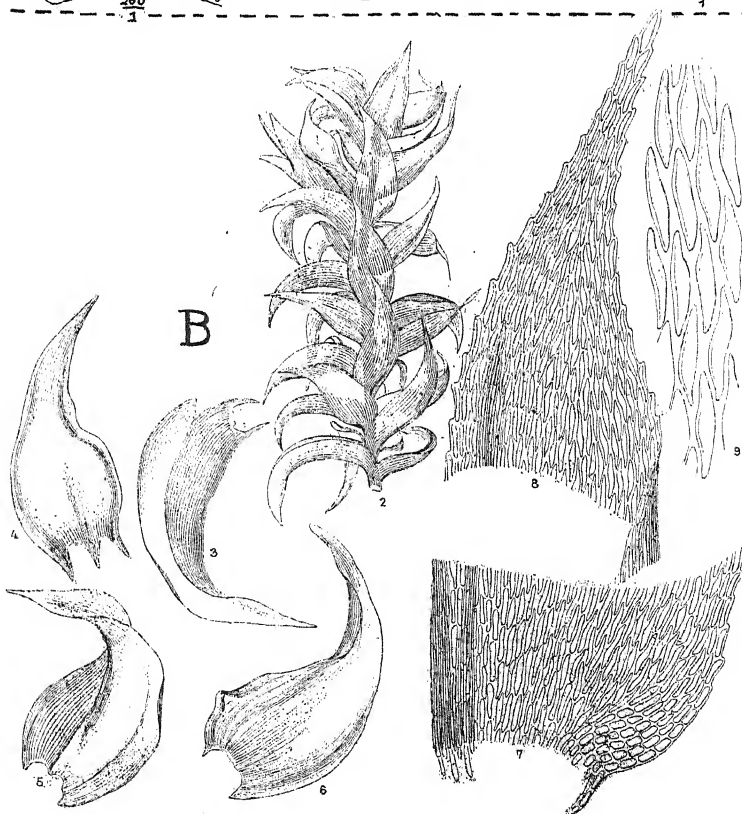
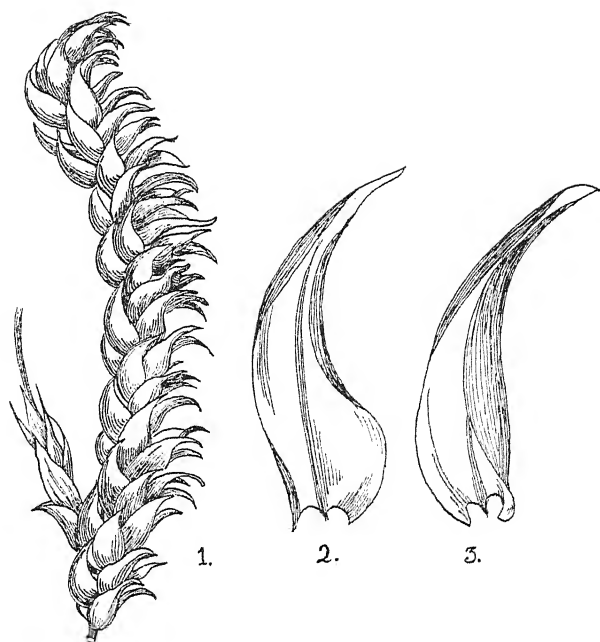
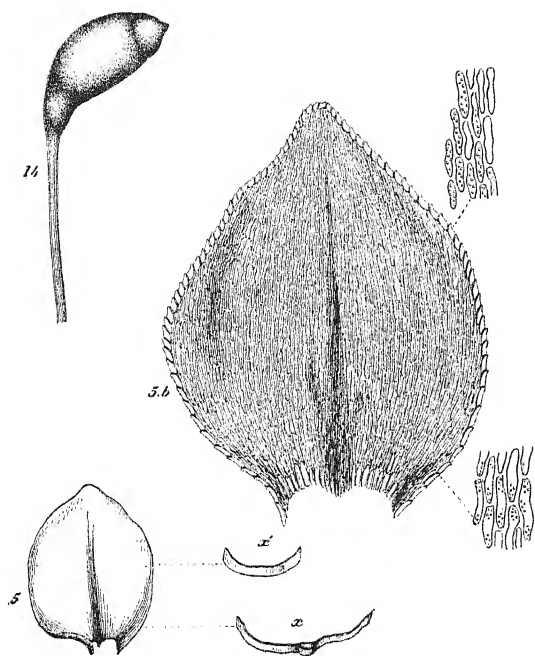
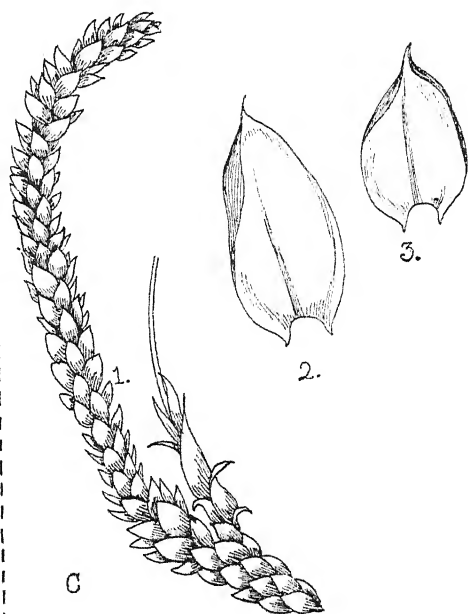
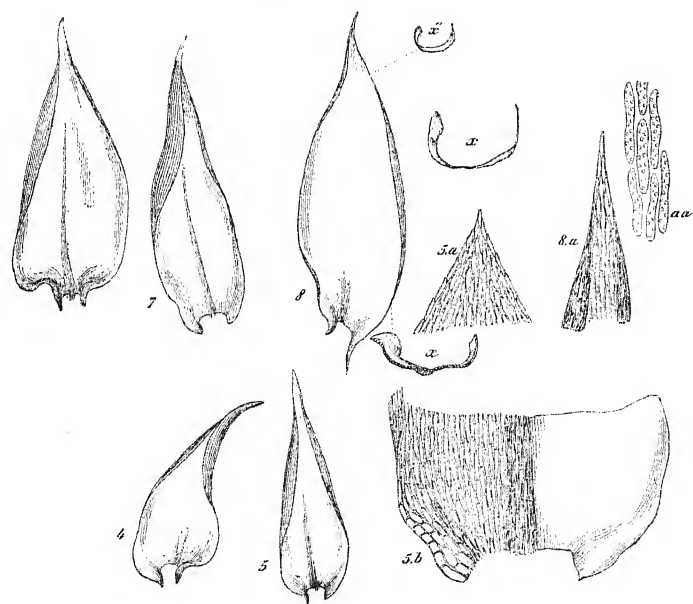


PLATE XXII.



D



C

Ed. de Linné a. 1753

PLATE 23. Upper left, *Hygrohypnum Smithii* (from Bry. Eur. pl. 578). 5, leaf much magnified; 5b, leaf showing cell structure (marginal cells incorrectly drawn); 14, capsule enlarged.

Lower left, *Hygrohypnum palustre* (from Bry. Eur. pl. 574). 4-8, leaves much enlarged; 5a and 8a, leaf apices; 5b, leaf base.

Upper right, *H. palustre subsphaericarpum* (Bry. Eur. pl. 575). 1, branch enlarged; 2 and 3, leaves.

Lower right, *H. palustre julaceum* (Bry. Eur. pl. 575). 1, branch enlarged; 2 and 3, leaves.

PLATE 24. A. *Hygrohypnum closteri* (from Bot. Gaz. 19: pl. 21C). a, entire plant; b, b, b, leaves; c, d, and e, cells from the basal angle, the middle of the leaf and the leaf apex, respectively; f, operculate and g, deoperculate capsule.

B. *Hygrohypnum pseudomontanum*. 1, lower portion of stem; 2, portion of upper part of the same stem; 3, 4, 5 and 6 leaves from lower portion of stem; 7, leaf from upper portion of stem; 8, median leaf cells; 9, basal and angular cells. Drawings made from the type.

C. *Hygrohypnum norvegicum* (from Bry. Eur. pl. 576). Three stem leaves and basal and apical cells.

D. *Drepanocladus aduncus* (from Bry. Eur. Suppl. Hypnum, pl. 1). B5, two stem leaves of a form approaching f. *Kneiffii*; 4b, lower portion of leaf showing cell structure; 4a, median leaf cells less enlarged than those in 4b.

E. Figs. 1 and 2, leaves and angular leaf cells of *Drepanocladus badius*. Drawings from a Spitzbergen specimen.

Figs. 4, 5 and 6, leaves, angular and median leaf cells of *Drepanocladus brevifolius*. Drawings from a Labrador specimen.

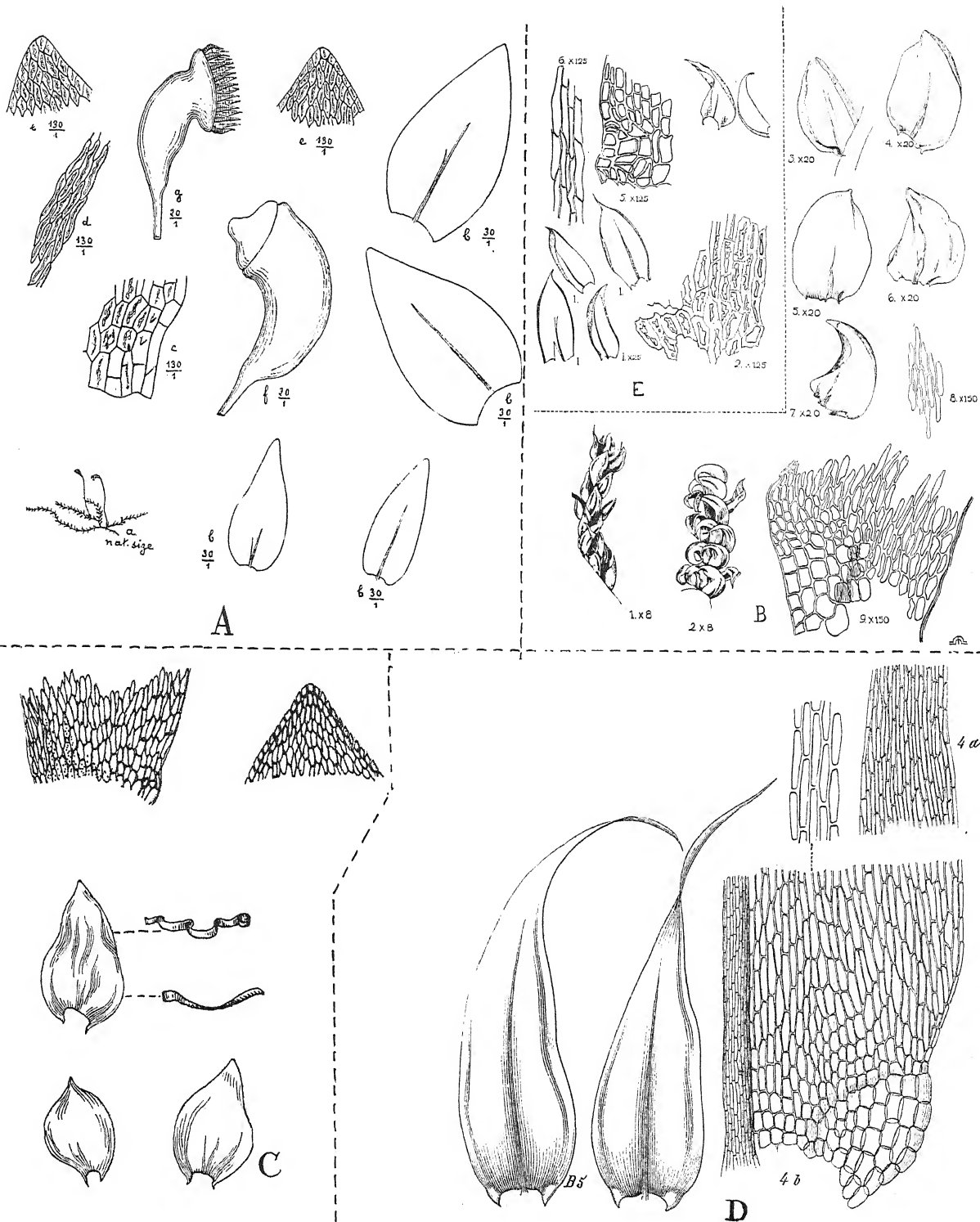


PLATE XXIV.

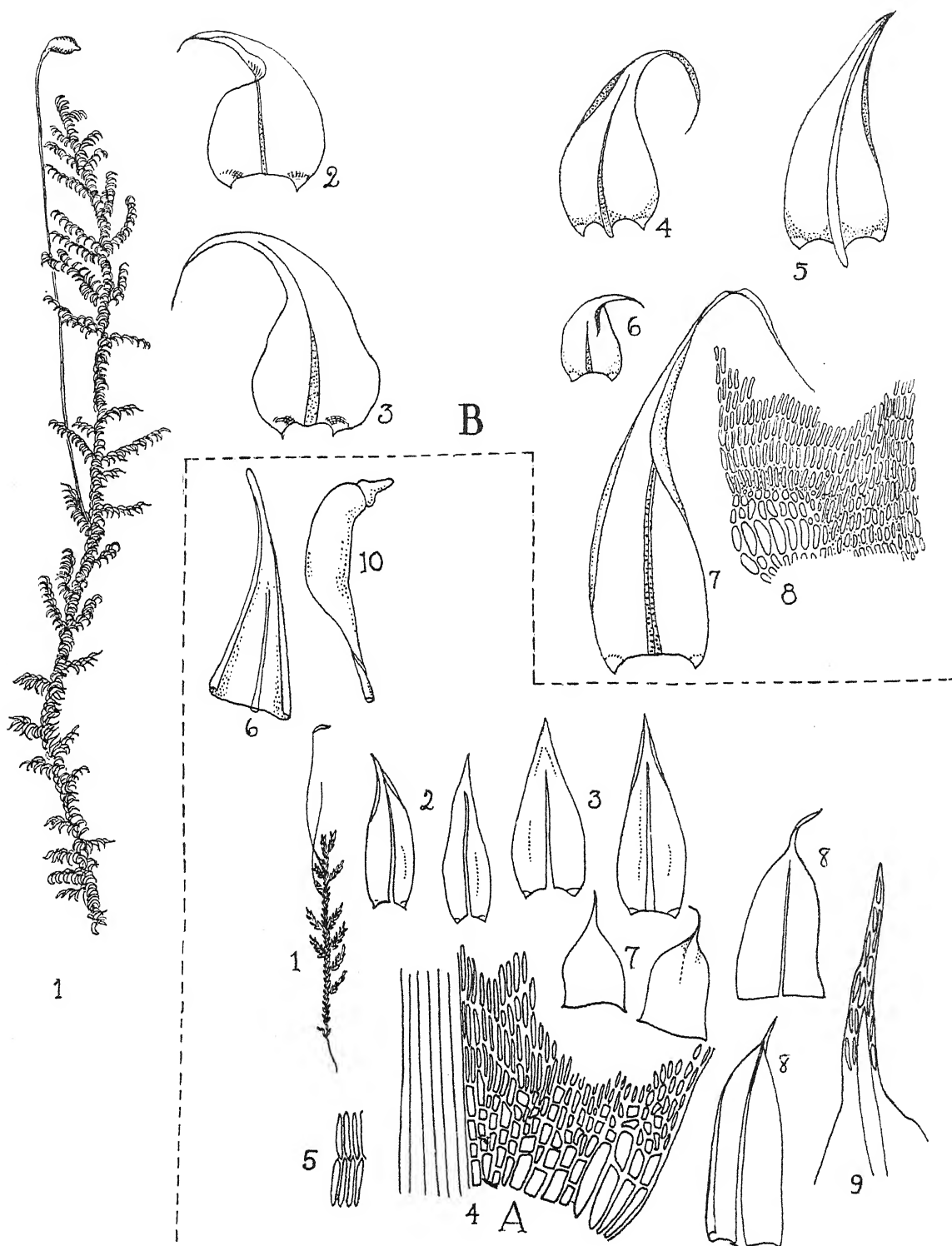


PLATE XXV.

PLATE 25. A. *Calliergon pseudosarmentosum* (Univ. of Calif. Pub. Botany 2: pl. 27). 1, plant $\times 1$; 2, branch leaves $\times 17$; 3, stem leaves $\times 17$; 4, basal areolation of a stem leaf $\times 135$; 5, median leaf cells $\times 135$; 6, apex of a branch leaf $\times 90$; 7 and 8, perichaetial leaves $\times 17$; 9, apex of a perichaetial leaf $\times 90$; 10, immature capsule $\times 13$.

B. *Drepanocladus Sendtneri* (figs. 1-3 from Limpr. Laubm. 3: 392, fig. 409). 1, plant $\times 1$; 2 and 3, stem leaves $\times 30$. 2, drawn from Bryoth. Siles., and 3 from an English plant. (Figs. 4-8 from Moenkemeyer in Pascher Suesswasserfl. 14: f. 48). 4, stem leaf of the normal form; 5, stem leaf of the "*capillifolius*" form with excurrent costa; 6, leaf of a form paralleling *D. aduncus polycarpus gracilescens*; 7, stem leaf of var. *Wilsoni*; 8, basal areolation of 4.

PLATE 26. A. *Drepanocladus lycopodioides* (from Bry. Eur. pl. 613). 1, plant $\times 1$; 2 and 4, stem leaves; 3, branch leaf.

B. *Calliergon turgescens* (from Dixon & Jam. Handb. Brit. Mosses (Ed. 3) pl. 60H). 1, stem leaf $\times 15$; 2, leaf base $\times 15$; 3, leaf apex $\times 60$; 4, median leaf cells $\times 180$; 5, alar cells $\times 180$.

C. Leaves and median leaf cells of *Hygrohypnum Bestii* (from Bryologist 4: pl. 3). Leaves $\times 16$, leaf cells $\times 200$.

D. Copies of the original drawings by Blandow to illustrate *Hypnum polycarpum*. 1, stem leaf and median cells; 2, branch leaf.

E. Stem leaf $\times 20$ and angular cells $\times 200$ of *Drepanocladus revolvens miquelonensis* from Musc. Am. Sept. Exsicc. 131 at the New York Botanical Garden.

F. *Drepanocladus aduncus Kneiffii*. Three stem leaves from Bry. Eur. pl. 573. This plate represents the type.

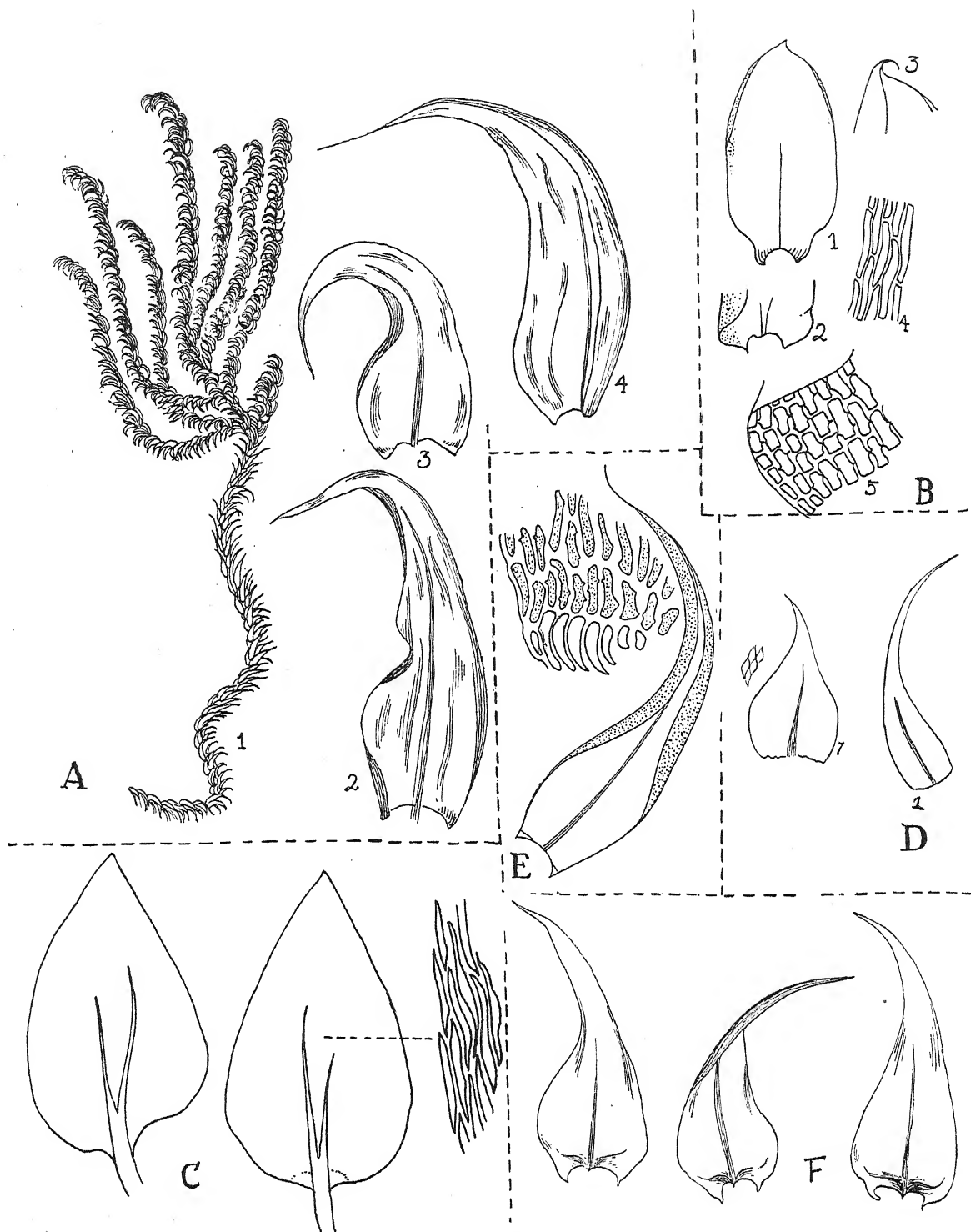
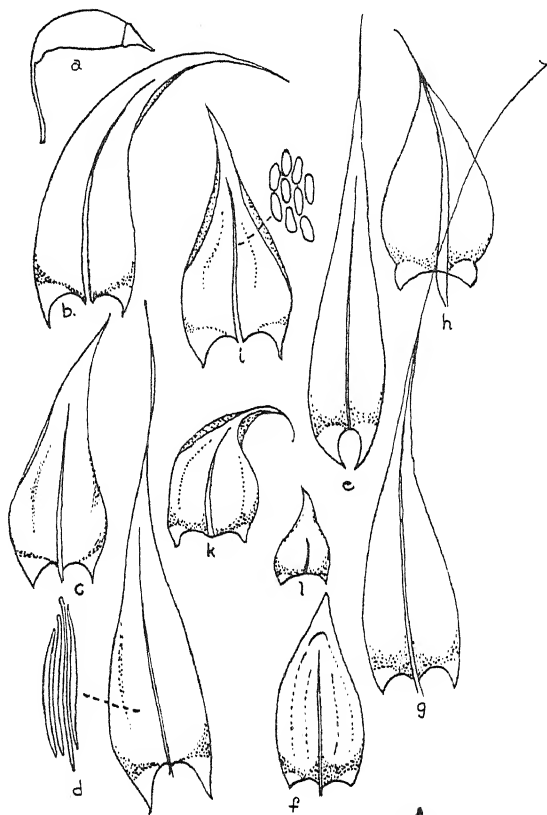


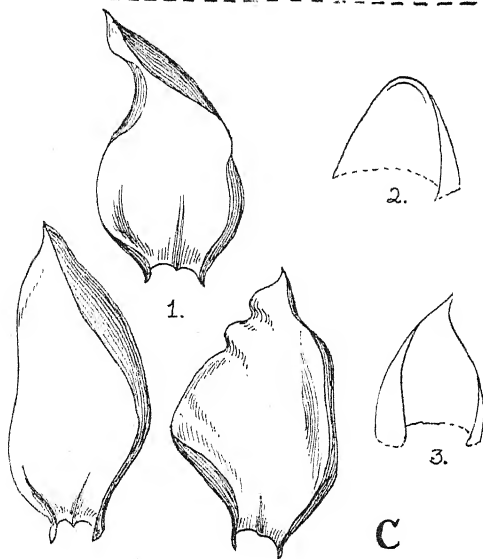
PLATE XXVI.



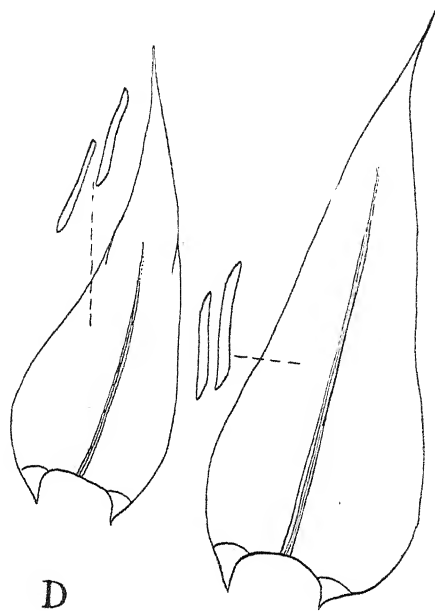
A.



B



C



D

PLATE 27. A. (from Moenkemeyer in Pascher, Suesswasserfl. 14: fig. 47). *a*, capsule of *Drepanocladus aduncus* $\times 4$; *b*, leaf of the same enlarged; *c*, leaf of var. *Kneiffii*; *d*, leaf of f. *aquaticus* with a few median cells greatly enlarged; *e*, leaf of var. *pseudofluitans*; *f*, leaf of f. *pungens*; *g*, a leaf of the *capillifolius* form of f. *aquaticus*; *i*, leaf of var. *polycarpus*; *h*, leaf of *capillifolius* form of var. *polycarpus*; *k*, leaf of var. *polycarpus gracilescens*; *l*, leaf of var. *polycarpus gracilescens tenuis*.

B. Two leaves and median leaf cells, much enlarged, of *Drepanocladus aduncus* f. *aquaticus* (from Husnot, Musc. Gall. pl. 105).

C. Three leaves and two leaf apices of *Scorpidium scorpioides*, much enlarged (from Bry. Eur. pl. 612).

D. Two leaves of *Drepanocladus aduncus* *Kneiffii* f. *intermedius* (from Husnot, Musc. Gall. pl. 106).

PLATE 28. A. *Drepanocladus aduncus polycarpus* f. *gracilescens* (from Bry. Eur. *pl.* 605B). 1, plant \times 1; figs. 2-7, stem leaves; 8 and 9, branch leaves; 1b, portion of plant enlarged; \times 5a and 5b, cells of leaf apex and base respectively.

B. *Drepanocladus revolvens* (from Bry. Eur. *pl.* 601). Figs. 3 and 4, stem leaves; 5 and 6, branch leaves; 4b, areolation of the lower portion of the leaf.

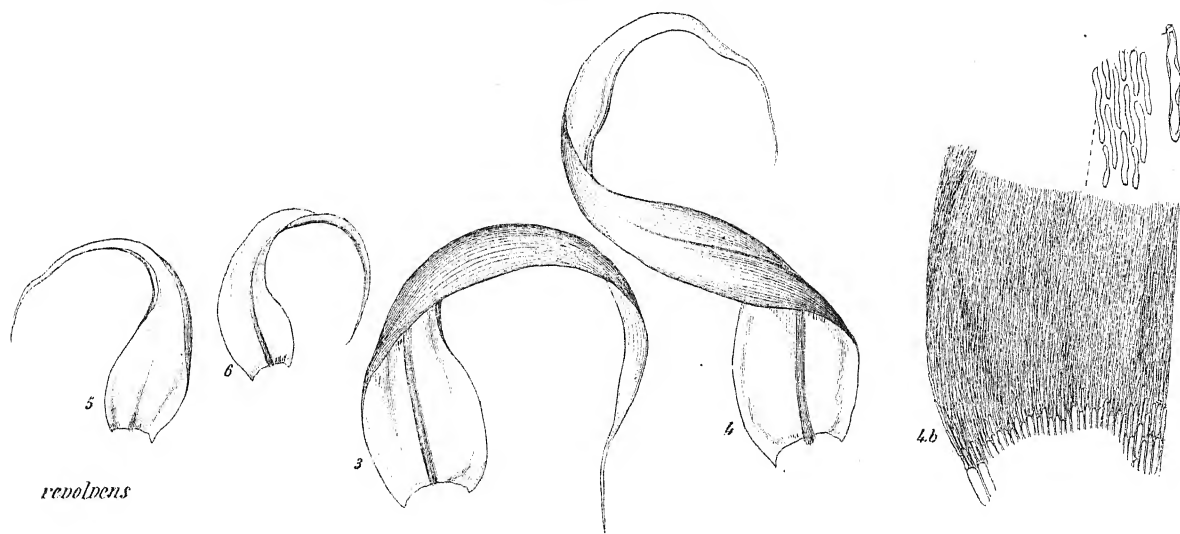
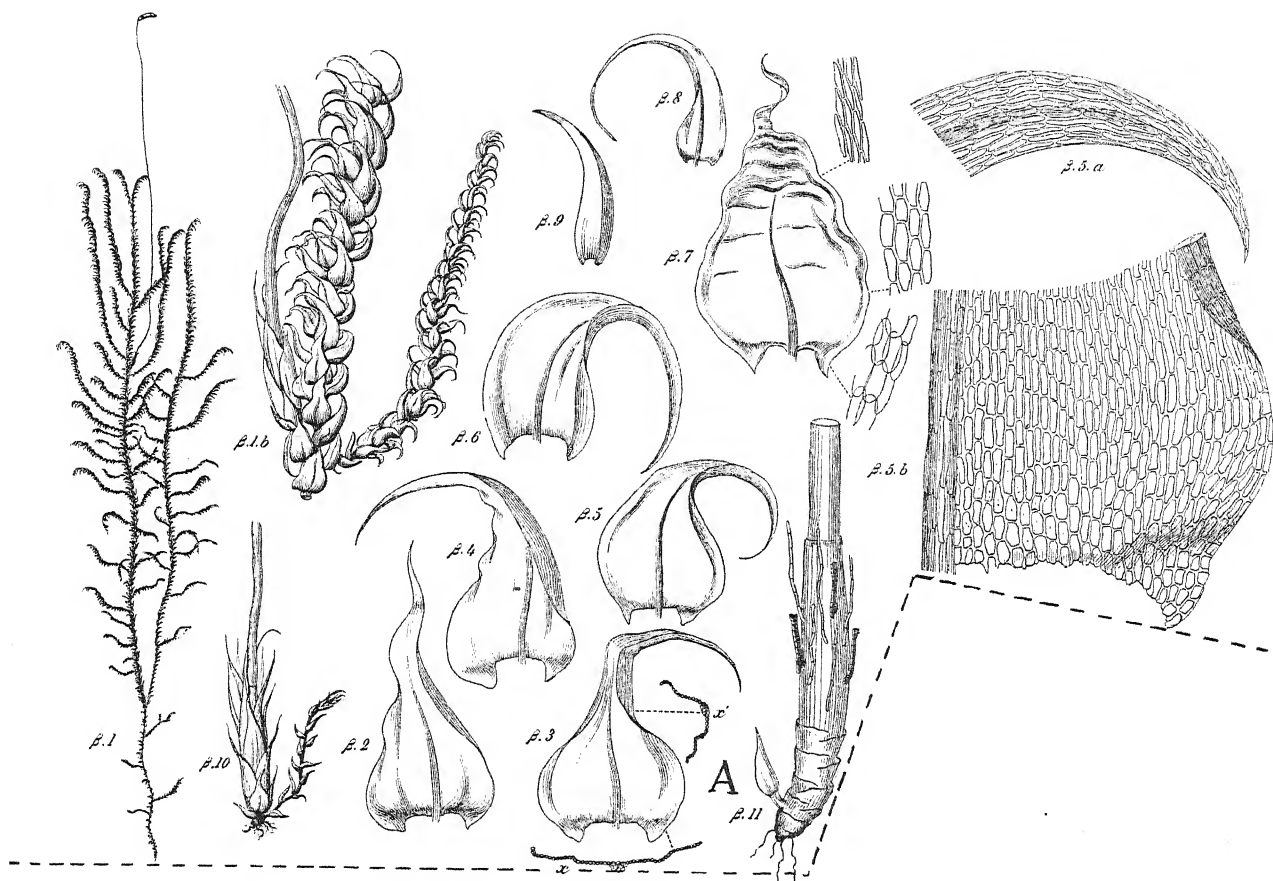


PLATE XXVIII.

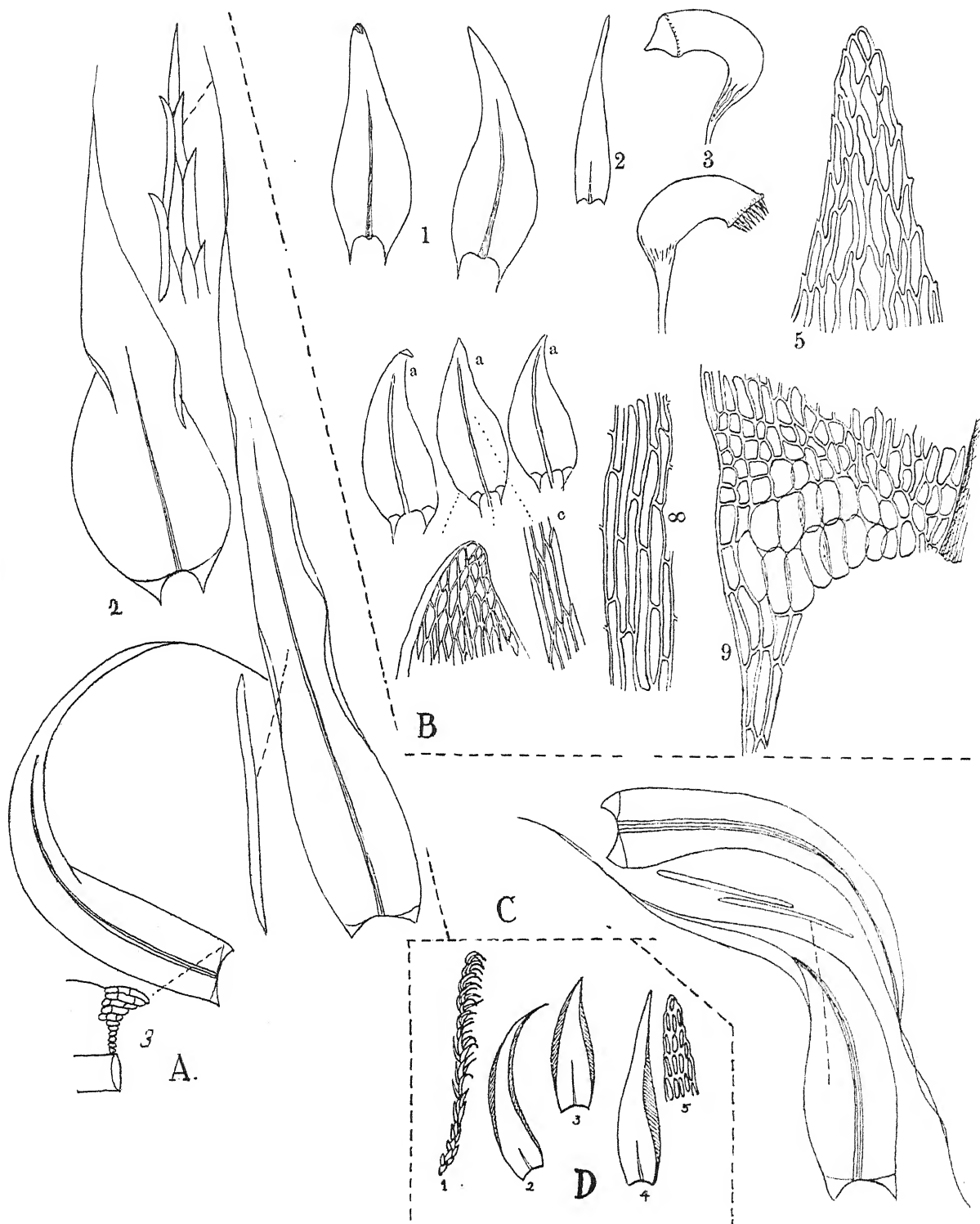


PLATE XXIX.

PLATE 29. *B. Drepanocladus exannulatus brachydictyus* f. *tundrae* (figs. 1-9 from Bull. N. Y. Bot. Gard. 2: pl. 24, as *Harpidium amblyphyllum* Williams). 1, stem leaves $\times 12$; 2, branch leaf $\times 12$; 3, capsules $\times 10$; 5, 8, 9, cells from apex, middle and base of leaf respectively $\times 285$. Figs. a-d (from Bryologist 4: pl. 7). a, a, a, stem leaves $\times 16$; c, median and apical cells $\times 200$.

A. *Drepanocladus fluitans* (from Husnot, Musc. Gall. pl. 109). Fig. 1, leaf and leaf cells of f. *setiformis*; 2, leaf of f. *submersus*; 3, leaf of a form of var. *falcatus* having rather long and slender leaves.

C. Stem leaves of *Drepanocladus exannulatus falcifolius* from Husnot, Musc. Gall. pl. 111.

D. Portion of stem $\times 4$, stem leaves and leaf apex of *Drepanocladus Berggrenii* from Monkemeyer, Laubm. Europ. 779, fig. 182.